THE MODEL ENGINEER

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The MODEL ENGINEER

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SMOKE RINGS

Our Cover Picture

● TO THE layman, the photograph selected for this week's cover will be something of a problem picture. I chose this picture because when I learnt what it portrayed I was not only interested but astonished, as I am sure many readers will be.

It is a photograph taken from inside the funnel of H.M.S. *Repulse*, and to me the immensity of the structure was almost incredible. Having no special knowledge of the subject, I imagined that a ship's funnel consisted of a bare tube for the purpose of carrying off smoke from the furnaces. But to find that it contains fiddley gratings, hand rails and other paraphernalia, excluding only the proverbial kitchen sink, was a surprising revelation !—P.D.

More Prizes for Exhibition Competitors

● OUR EXHIBITION MANAGER tells me he has abolished the entrance fee for the Competition Section this year, and together with this good news has handed me a list of donations already received for prizes in this section of the Exhibition. These prizes, which are additional to those announced in my "Smoke Ring" of June 10th, are as follows :—

The New York Society of Model Engineers, Inc.—Two guineas to be awarded to a non-commercial exhibitor of a completed working model who has not previously won a prize—at the discretion of the judges.

The Westbury Prize.—Two guineas for the most original design of an i.c. engine entered in the competition.

The C.M.L. Prize.—Value two guineas.—For the best i.c. engine having more than one cylinder.

The Hampshire Prize.—Two guineas donated by Mr. C. Hampshire for the best miniature marine model of 1/32-in. scale or under.

The Muller Prize.—Value £2 5s.—donated by Mr. J. V. Muller of Capetown, for the best example of model railway equipment.

I am told that other prizes will be forthcoming, and I will announce these later as details come to hand.—P.D.

Transport for Exhibition Models

● THIS YEAR we have been endeavouring to organise a service whereby models can be collected at various centres and transported direct to the Exhibition by road. This is intended primarily for large ship models but it may be applied to delicate models which require special care. As was to be expected, there has been some difficulty with regard to the allocation of petrol, and the position is still not clear. We have, however, had more success with the Railway Executive. They have undertaken to pay particular attention to models being sent to the "M.E." Exhibition, and, to assist them, we have had special labels printed. These labels may be had by anyone

sending a model, on application to the Exhibition Manager at this office. This application should be accompanied by particulars stating from which station and on which day the model is being dispatched. The Railway Executive will then notify the station in question so that special arrangements may be applied. A specially reduced rate has been fixed for models sent under this arrangement, which is another reason why modellers should co-operate with us in taking advantage of the Executive's helpful interest. If and when petrol is allowed so that we can operate a scheme for road transport, particulars will be announced. In addition, interested parties may be notified immediately by post if they will send in their names and addresses.—E.B.

A George Stephenson Centenary

● AUGUST 12TH next will be the hundredth anniversary of the death of the "Father of Railways," George Stephenson. Since he was directly responsible for much of the railway development in and around Chesterfield, where he lived and died, a programme of appropriate exhibitions and ceremonies is being arranged. On August 12th, an official Opening Ceremony will take place in the Town Hall, Chesterfield, at 2 p.m. From August 12th to 15th, a Railway Exhibition, organised by the British Railways Executive, will be open at the Market Place Station, Chesterfield. From August 12th to 28th, the following exhibitions will be held :—(1) An Engineering Exhibition, organised by various local firms, with the co-operation of the Chesterfield Model Engineering Society, the local Technical College, representatives of the Institutions of Civil, Mechanical and Mining Engineers, and Theo. Pearson, J.P., at the Boythorpe Road Drill Hall ; (2) a Mining Exhibition, under the auspices of the National Coal Board, at the Ashgate Road Drill Hall, and (3) a Stephenson Exhibition, organised by the Chesterfield Borough Librarian, at George Stephenson's home, Tapton House. I hope that all readers who can, will make a note of these functions and the dates. —J.N.M.

Greetings from "Down Under"

● IN WRITING to congratulate THE MODEL ENGINEER on the occasion of its fiftieth anniversary, an old reader, Mr. Frank Roberts, of Epsom, New Zealand, recalls some interesting early experiences in model engineering. Mr. Roberts's acquaintance with THE MODEL ENGINEER dates back to 1900, and he has nearly completed his nineteenth model locomotive, an electrically-driven American N.6 Richmond type ; the twentieth, a double Fairlie type, with four sets of Walschaerts valve-gear is already under construction. Several years ago, Mr. Roberts built his own motor car, a lightweight with hardwood chassis, and powered with a 4½ h.p. F.N. motorcycle engine (how many of our readers can remember these wonderful old four-cylinder engines ?). The transmission was by friction drive and worked very successfully. The chassis was later reconstructed with parts taken from a very ancient 2¾ h.p. car with vertical steering column. In its final form, the car was very advanced for its period, being fitted with electric lighting and embodying the unique feature of a starting handle on the dashboard. It ran well for seven years without a single breakdown, and was eventually sold for £40. Mr. Roberts's model railway has recently featured in a broadcast by the New Zealand main station IVA in the Children's Hour programme. Afterwards, the locomotive engineer of the Auckland Railways rang up to compliment him on the performance of his locomotives, but drawing attention to the fact that the K.900 locomotive seemed to be slightly off beat ! As this locomotive was built in 1936 and has been hard at work since, without a single overhaul or even re-packing of the glands, this is hardly surprising. Among his other activities, Mr. Roberts is also a keen radio amateur, and his call sign is ZL-1-TW. He concludes by saying "No other type of journal can compare with THE MODEL ENGINEER . . . it never falls off, is most consistent in quality, yet always provides something new."—E.T.W.

Intelligence on Tap

● I RECENTLY attended a brains trust session held by a well-known model engineering society, at which members were invited to bring forward practical queries for consideration on the spot by a panel of experts. This idea is, of course, by no means, a new one, either in model engineering or other circles, but it deserves to be much more widely exploited, in view of its usefulness in eliciting just the kind of information that model engineers, and in particular beginners, are looking for. At every meeting of a model engineering society, many discussions take place, and questions are asked and answered, but there are great advantages in having these matters organised, rather than carrying them on as an unofficial and semi-private part of the proceedings. The information provided by lectures, even those on the most popular subjects, is not always exactly what members are looking for, or the subject may not be treated from the most suitable angle, but by devoting an occasional meeting to dealing with queries in this way, whether the session is known as a Brains Trust, Question Night or Query Corner, not only can the members get the kind of information they are really looking for, but the society is enabled to keep in close touch with its members' views and requirements. —E.T.W.

Photographic Competition Extended

● I HAVE been asked by several readers who are anxious to enter for our Photographic Competition (first announced in our May 6th issue) if I will postpone the closing date, as they are unable to send their entries within the specified time. In view of the present difficulties in obtaining photographic materials, I have decided to extend the period of the competition for an additional four weeks to give those wishing to take their own photographs more opportunity of obtaining materials. The closing date, therefore, is now July 19th, instead of June 21st. There are no doubt many who, like myself, find that 24 hours to the day are only just enough. For such as these, I hope this concession will enable them to find that odd half hour between the end of one job and the beginning of the next in which to complete their entry.—P.D.

A $1\frac{1}{4}$-in. Scale Traction Engine

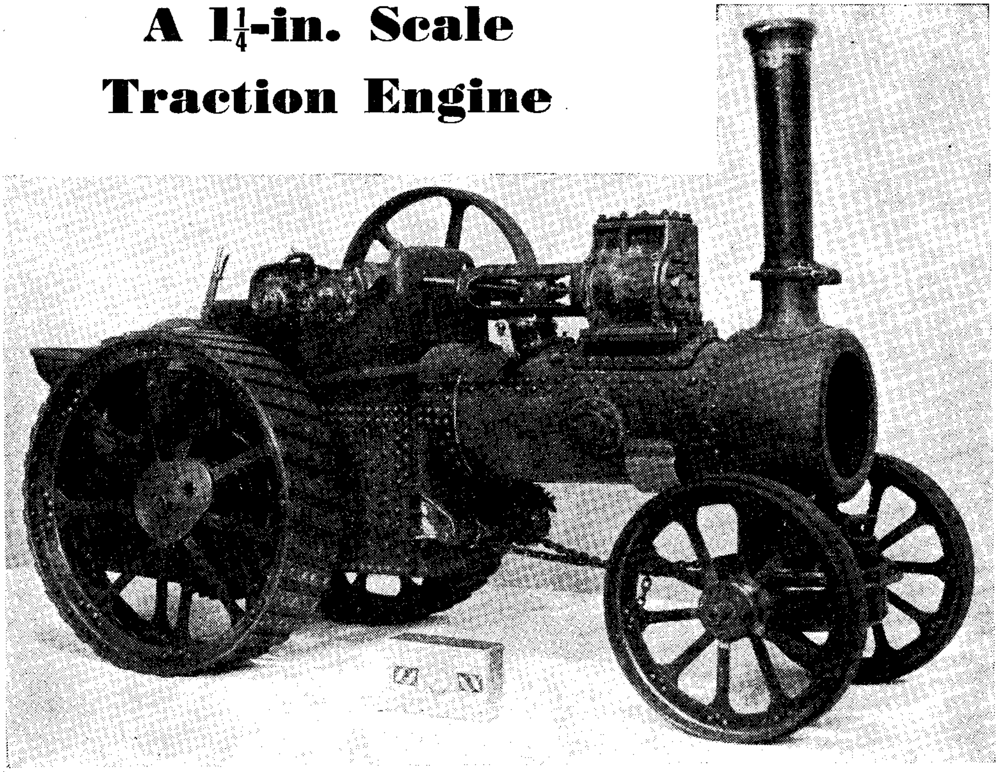


Photo by] *Photo No.* 1. *Mr. G. W. Cox's partly finished scale traction engine* [*R. F. Rowell*

THE photographs reproduced here show a $1\frac{1}{4}$-in. scale model traction engine, which I have at present under construction, and they may interest some of your readers. The model represents a Ruston and Hornsby Class "SH," size 7 NHP agricultural engine as turned out by the firm about 1922.

Boiler

The boiler is of copper and is built-up in the same manner as the prototype, the flanged plates being beaten out over wooden formers. Caulking-strips are fitted between the boiler shell plates and hornplates, although soft solder is actually used to make the joints tight. The tubes are, of course, not to scale, there being seven $\frac{1}{2}$ in. O.D. tubes expanded into each tube-plate. The boiler was a big job, absorbing a total of 670 hr. working time. The working pressure is 40 lb. per sq. in. The rear road wheels are built up from steel T-irons, with the strakes riveted on, and the hubs are fabricated. The front wheels are of similar construction, with a steel tyre in three sections.

The cylinder block is fabricated from sheet and bar brass, and is correct to scale externally, although it is modified slightly inside to suit the method of construction. It is steam-jacketed and provided with the necessary ports for the governor-valve, etc; 57 separate pieces were employed in its construction, excluding covers, glands, studs, etc., and the parts are silver-soldered together.

The bored guide, runner bracket and main bearing brackets are likewise built-up in brass and steel, as also are the differential housing. The slip-winding drum and brake drum are shown in Photo 2.

Gears

The flywheel is an actual casting, obtained through the good offices of a friend, and with the exception of about 70 per cent. of the rivets used on the job, is the only part not made-up from bar and sheet material. The gears were cut by form-milling in my 3-in. centre treadle lathe which, incidentally, is the only machine tool I possess, a multi-tooth form cutter being made from cast-steel bar for each size wheel. In cutting a wheel, the cutter was mounted on a mandrel running between centres, and the wheel-blank carried on a horizontal stub-arbor clamped to the lathe cross-slide, and arranged so that it could be traversed at right-angles to the line of centres. Indexing was effected by dividing up circles on a large card carried at the back of the lathe stand and arranged to register with the gear blank, each division on the card being lined-up with a fixed pointer before cutting a tooth space.

In order to make the worm-wheel for the

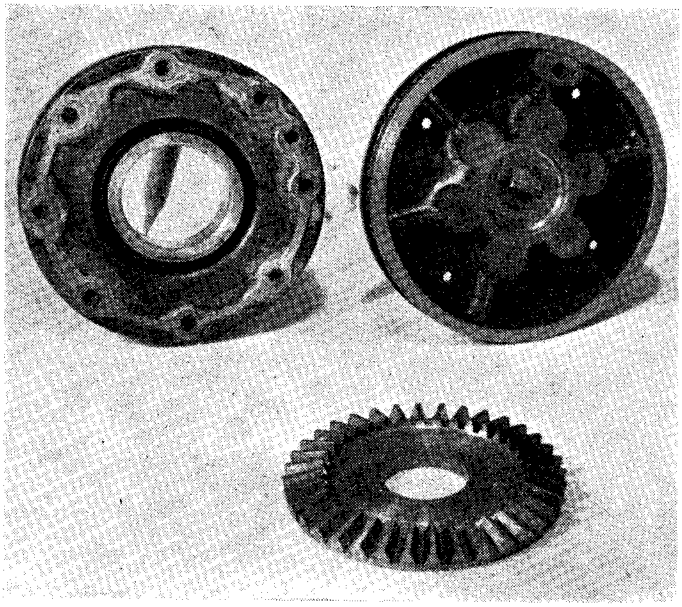


Photo No. 2. The slip-winding drum, brake drum and one of the bevels for the differential

steering gear, the blank was first gashed out with a form-cutter, leaving about 20 thou. on each tooth flank for finishing. A hob blank was next turned from silver-steel, grooved, and the teeth so fomed backed off. The finished hob was run between centres and the part-finished worm-wheel blank mounted on a stud carried from the cross-slide. By feeding the wheel blank forward, the hob was sunk into the blank and the teeth completed, giving a very good gear.

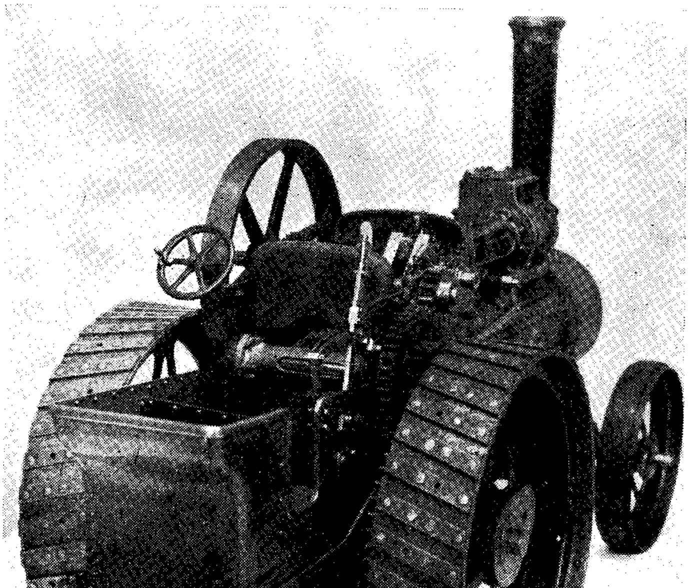
The bevels for the differential, one of which is seen in Photo 2, were cut by a slight modification of the method already described for the straight spur gears.

All the gears are in steel and correct to scale as regards circular pitch, but the addenda and dedenda have been slightly altered from standard proportions in order to avoid interference and undercutting.

The model was commenced at the beginning of 1942, and, as will be seen from the photographs, is now well advanced, the only major sub-assemblies remaining to be completed being the boiler feed-pump, which will be fitted in the tender, and the Pickering governor. There are, however, numerous details, such as safety-valves, control gear, smokebox door, brake operating gear, winding bollards, gearguard, etc., which will have to be made before the boiler can be lagged and the engine completed—

G. W. Cox.

[Mr. Cox is to be congratulated upon producing a model which, when completed, will be a very fine piece of model engineering craftsmanship. As the next generation of potential model engineers will have few opportunities, if any, of seeing these machines at work, it is fortunate that there will be many fine working models to enable them to learn something of the engines designed by their grandfathers.—Ed., " M.E."]



Photos by] [*R. F. Rowell*

Photo No. 3. Rear end view of the scale traction engine

A Simple Extractor Fan

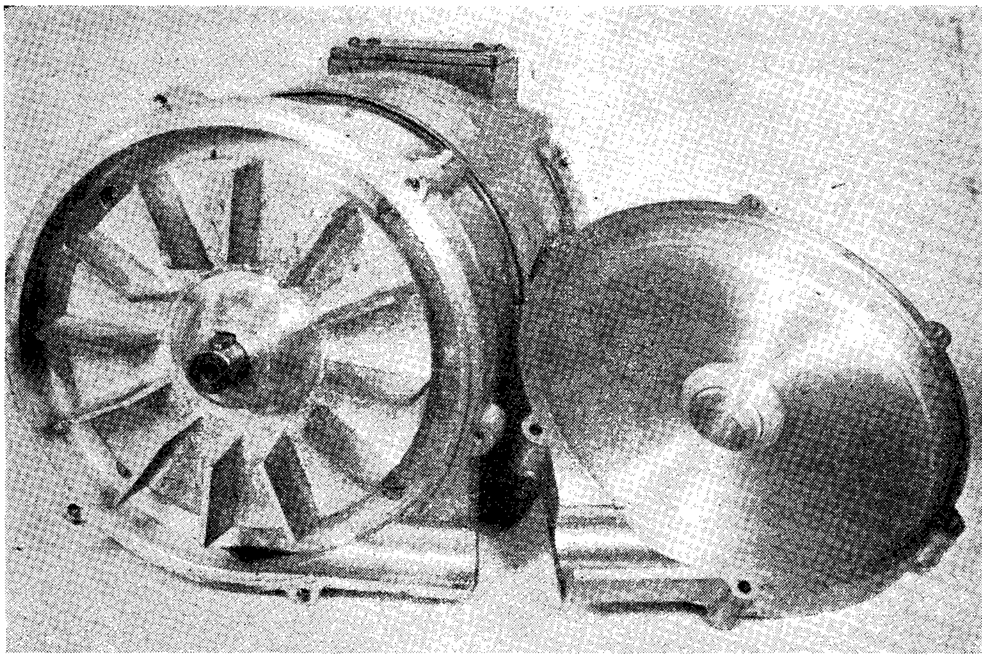
by "Ned"

THE subject of this article may possibly be considered a little outside the normal scope of model engineering, as it is a utility appliance, designed to fill an industrial need, but it is a good example of work within the scope of the amateur workshop, and entails several rather interesting exercises in workshop practice.

The fan was constructed for a friend in the electrical manufacturing trade, who had installed an electrically-heated oven for the purpose of stoving the windings of transformers and other electrical apparatus. This was found to produce unpleasant, and possibly inflammable, fumes through the evaporation of the varnish, and attempts to carry off the fumes by natural convection, by fitting a vertical outlet pipe to the vent of the oven, proved inadequate, as the size of the vent was limited and could not readily be increased in size, and in addition the oven-door joints were not air-tight.

A temporary solution to the trouble was found by fitting a small enclosed fan driven by a universal motor, essentially similar to a vacuum cleaner. This, however, was not entirely satisfactory, as the motor ran at high speed, and was rather noisy in operation. The fan also was liable to clogging through re-condensation of varnish in the fan casing, so it was eventually decided to fit a much larger motor running at a much lower speed, and having suitable provision for avoiding the risk of clogging the moving parts.

After obtaining a suitable motor, an attempt was made to fabricate a rotor and casing from sheet metal, but difficulties arose in making a sound job by these methods, and it was eventually considered more satisfactory to make these parts from castings.



The fan mounted on $\frac{1}{4}$ h.p. motor, with front half of casing removed

It may be remarked that no claims are made for the efficiency of the design of this fan; as a matter of fact, its design is known to be far short of ideal, as the inlet and outlet passages are too small for really good airflow efficiency, but they were limited in size by having to fit to the existing pipes already fitted to the oven vent, which were 1 in. external diameter. In other respects, the design has largely been dictated by the machining facilities available, and convenience in making the patterns and castings. One or two points about the pattern-making may be of interest to readers.

In the case of the fan rotor, which was cast in light alloy, the pattern was built up, using a wooden disc as the back-plate, with an attached centre boss and hardwood blades, each carefully tapered for draught, and glued into

grooves cut in the disc with the aid of the lathe milling attachment. It will be noted that the rotor blades are straight and set radially, which is not necessarily the most efficient type of blade, but it has the merit that it works reasonably efficiently when run in either direction. This gives some choice, not only in the direction of motor rotation, but also in the position of the outlet port of the casing. It is clearly desirable to allow the air to escape from the casing at a tangent in the same direction as the rotor blades are moving. The pattern for the half casings was also built up with a flat disc for the back-plate and segmental pieces glued on around this to form the sides. After fabricating this part of the pattern, it was machined inside and outside, and the lugs to take the bolts were glued on around the sides.

An interesting point arises in respect of the lug for the delivery pipe. In the normal way, it would be necessary to make a pair of patterns for the two half casings, right- and left-hand respectively, but in order to enable the two castings to be made from a single pattern, this lug was simply made in the form of a square-cornered extension, no attempt being made to pre-form either the external or internal shape of the passage in the casting.

After machining up the castings for the half casings, one having a spigot and the other a recess to register them concentrically, the delivery lug was bored and faced by holding the assembly on the cross-slide of the lathe. It should be noted that the casing is not mounted concentrically with the rotor shaft, but is set over slightly in order to provide an increasing area of the annular passage around the rotor, with its largest area in the region of the delivery port. Thus, the rear side of the casing which fits over the boss of the driving motor bearing is slightly eccentric, and the centre of the other half-casing, which forms the inlet to the fan, was bored in line with this, after the casing was assembled. The inner side of the inlet passage is flared to give as easy an entry as possible to the centre of the fan rotor.

In order to attach the rear half-casing to the motor, the four bolts which hold the motor-casing together were provided with extension nuts, in the form of pillars of equal length, against which the half-casing rests, and is secured by countersunk screws from the inside. The centre bore of this part of the casing fits snugly over the motor-shaft bearing, but is greater in depth than the latter, and provides a recess which is fitted with a thick felt washer, having provision for an oil feed so that it can be kept well saturated with thin oil. The boss of the rotor, which is keyed to the motor shaft, enters slightly into this recess and bears against the felt washer. This forms a gland which excludes any varnish carried over from the fumes of the oven from reaching the motor bearing, and should any tendency to clog the felt washer be experienced, it can be freed by feeding penetrating oil to the washer. All other parts of the moving shaft and rotor have sufficient clearance in the casing to avoid any risk of becoming clogged.

This fan works quite silently at a motor speed of 1,425 r.p.m., and has proved thoroughly effective in removing the varnish fumes from the oven.

The risk of condensation taking place in the fan casing is avoided to a great extent by placing the delivery port at the lowest point in the casing.

Safeguard for a Series Motor

HAVING recently acquired a Government surplus rotary convertor, adapted as a series mains motor (as per "Artificer's" instructions), I quickly rediscovered the inherent fault of all series motors—I refer to their ability to run away if the load is removed.

In my case I am using it to drive a centrifugal pump (built from scrap incidentally—good old scrap box!), to pump water from a pond, and when, as does happen on occasions, the water falls below the suction inlet, taking the load off the pump, the motor runs away. To limit the speed to a safe level I adopted the following idea which I have not seen applied before—hence my reason for writing this in the hope that it may be of some use to others.

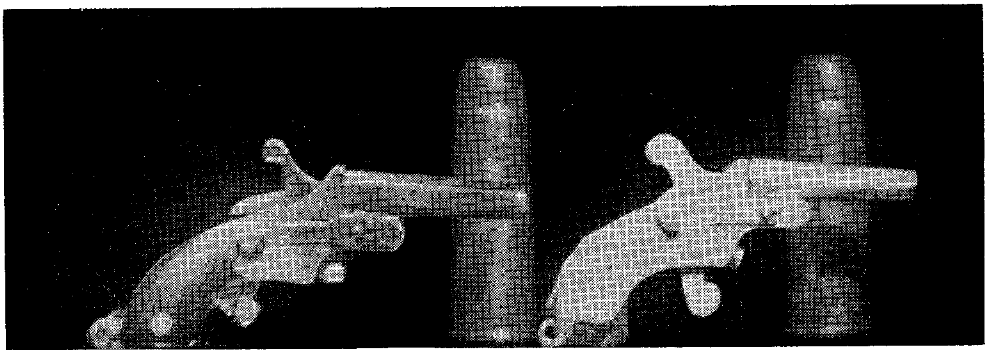
The reason why a series motor runs away if off-load is not easy to explain without going into technicalities, but it is due to the back E.M.F., which limits the current taken, being dependent upon both the strength of the field magnetism (proportional to current flowing), and armature speed. Increasing armature speed causes less current to flow, reducing field strength, which necessitates increased armature speed to give same back E.M.F. to restore mains voltage balance. This reduces current and field strength again, and so the vicious circle continues, until something reaches the limit of endurance—meaning usually a wrecked motor!

If the field current can be prevented from falling below a definite minimum level, all will be well. I achieved this by placing a lamp in parallel with armature (series with field). The little current taken by the lamp is not dependent directly upon armature speed, and forms the minimum level mentioned above. A little experimenting showed that a 25-watt mains lamp sufficed with my motor and pump, without reducing the power output too much; of course, if the coupling between motor and pump should come adrift, the motor will still race to a high speed, but at least it gives one a little more time to get at the switch!—E.T.P.

Miniature Lethal Weapons

by E. W. Smith

WHILST serving with the R.A.F. a friend showed me a model pistol, and having always been interested in models I thought a pistol would be something unusual to make. A rough sketch was made of the external parts, but as the model was riveted together the internal part could not be seen and much was left to imagination.

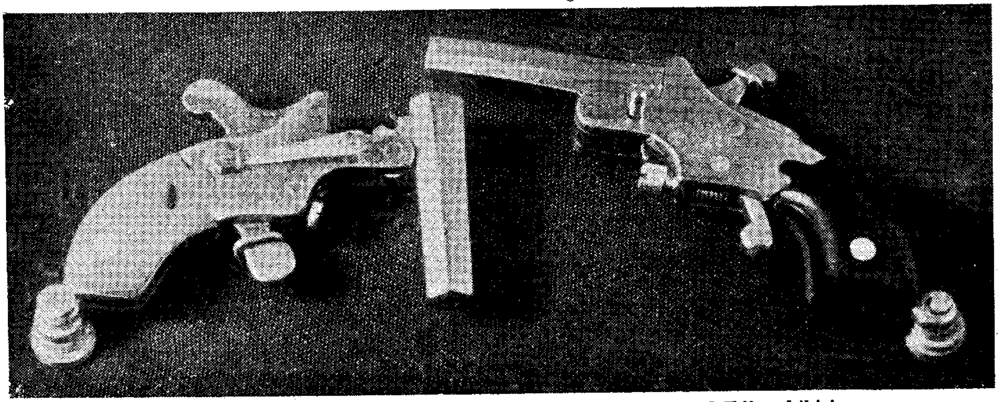


The two model pistols compared with .45 cartridges

A few scraps of mild-steel were obtained and I set to work. The stock was made first from a piece of ¼-in. steel, this was filed to shape and cut down the centre with a hacksaw, using two blades to allow the trigger, hammer and barrel to fit in. The barrel was made next, a 5/64-in. hole was drilled through a piece of mild-steel, this was opened out to 3/32 in. to a depth of 3/16 in., and opened out to ⅛ in. to a depth of 3/64 in., to take the case of the cartridge and the rim. After the barrel had been drilled it was filed to shape and fitted to the stock and riveted to allow the pistol to be broken for loading. The clip to lock the barrel into position is a 1/16-in. pin, held in by the spring on the side. A flat was filed in the centre and when the pin is pressed in, a hole in the bottom of the barrel, which was half filed away, lines up with the tfla on the pin and allows it to be opened.

Now came the more difficult part. Two pieces of cardboard, to act as templates, were cut to what I thought was the shape of the trigger and hammer, and pinned to a piece of wood and cut until they appeared to work together. They were then copied from a piece of 3/32-in. mild-steel, but alas, when fitted to the pistol, they would not work. After making about a dozen of each piece, a pair were found to work quite well and case-hardened. Several attempts to make a spring were unsuccessful, and eventually a cut-off safety-pin was used.

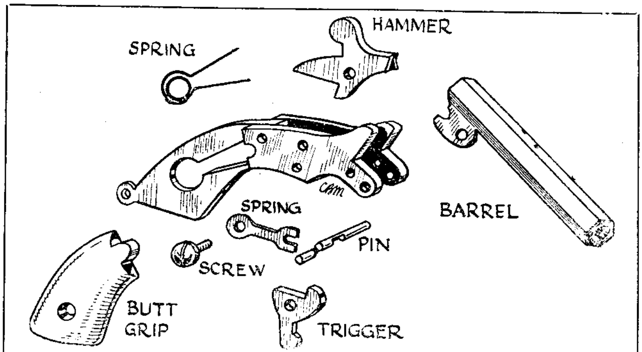
The grips on the butt were of vegetable



Further views of the model pistols, as shown at the 1947 "M.E." exhibition

ivory, which is to be found in Southern Rhodesia where I was stationed.

The pistol I have described is on the left of the first photograph, taken by Mr. Cramb, the photographer for the Newbury Model Engineering Society, of which I was a member, the one on the right is of similar design but slightly larger, the bore being $\frac{1}{8}$ in. and the grips on the butt being of bakelite.



An exploded view, showing details of the model pistol

The cartridges in the background are for a .45 Colt, and give some idea of the size of the model. With regard to ammunition, several unsuccessful experiments were carried out. Cartridge cases were turned from pieces of copper and filled with "Swan" match-tops, but the "safety-pin" spring is not strong enough to fire them. Experiments are still proceeding.

A Simple Miniature Bulb Holder

by H. Gardner

HAVING a job to do which required several dozen small bulb holders, I was faced with either paying about 7d. each for same or making them myself. After a little careful thought I designed the following holder, which was simple to make and quite effective in use.

very thin sheet brass is cut $\frac{3}{16}$ in. × $\frac{3}{4}$ in. and bent as in Fig. 3. This is nipped on the fibre as shown in Fig. 5. A short length of 18-gauge brass wire is now wound round a piece of $\frac{5}{16}$ in. diameter rod and the ends bent down as shown in Fig. 4. This is soldered to the body of holder.

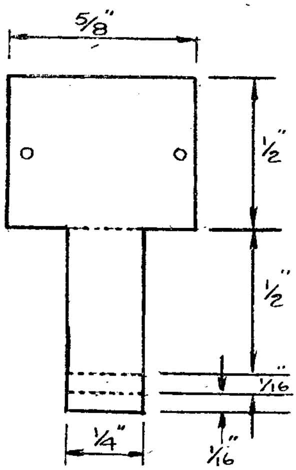


Fig. 1

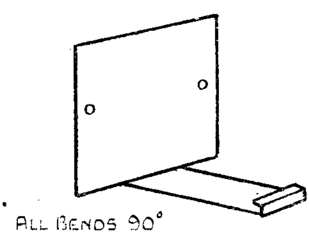


Fig. 2

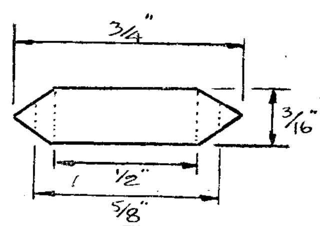


Fig. 3


Fig. 4

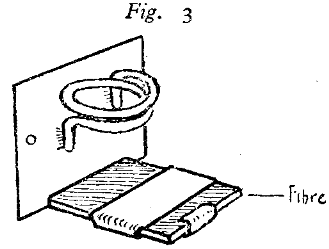


Fig. 5

A small piece of sheet brass or stout tinplate is cut to shape shown in Fig. 1. This is then bent up as in Fig. 2 and a small piece of $\frac{1}{16}$ in. thick sheet fibre is cut $\frac{1}{2}$ in. × $\frac{1}{2}$ in. and inserted in the holder and the small tag at end is nipped down on the fibre, to secure it. Now a small piece of

The connections are soldered to the body and brass piece, Fig. 3, respectively.

In my case the securing holes were deleted, as the holder was soldered direct to a metal strip, which contained several holders in line. This strip, of course, was made one of the contacts.

A Direct-Drive for the Grinder

by E. M. Graville

THE workshop, in which this direct-drive arrangement is installed, is powered by a ½ h.p. motor, bolted, in an inverted position, to the ceiling joists. It drives a main shaft at 285 r.p.m., which in turn drives countershafts to the lathe, drilling machine, etc., at appropriate speeds. The normal procedure would be to use a countershaft for the grinder, but these high-speed machines absorb a good deal of power, and there is little margin in a ½-h.p. motor to waste in profitless turning of countershafts. Therefore, a direct-drive from motor to grinder is indicated, so that countershafts can be dispensed with.

The motor is a double-ended induction type, with no starter windings, and the first method tried was to use the spare end of the motor and fit it with a suitable pulley. Apart from the inconvenience, however, it was found that in spite of much energetic pulling on the driving belt, it was impossible to rev. up the motor sufficiently to enable it to pick up the load.

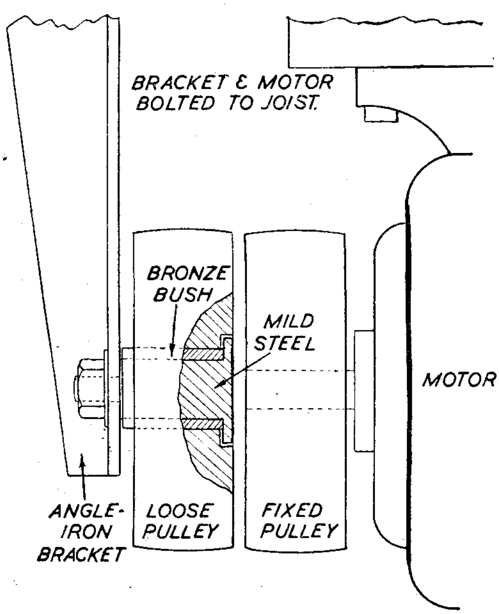


Fig. 2. Showing details of loose pulley, bush and shaft

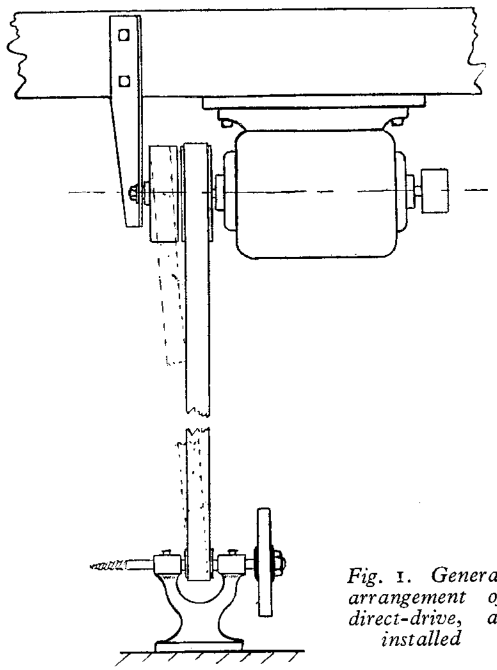


Fig. 1. General arrangement of direct-drive, as installed

Therefore, the arrangement shown in the drawings was finally chosen and has proved to be the solution to the problem.

The "spare" end of the motor carries a 4-in. pulley. Near it, and in line, but independent, is another 4-in. pulley. This is bronze bushed, and runs freely on a short steel shaft, which is reduced and threaded at one end and fixed to a bracket of bedstead angle-iron bolted at the joist.

The pulley on the motor lines up with a 2-in. pulley on the grinder. At rest, the belt goes from the grinder to the loose pulley, and the motor is free to drive the main shaft by the belt at the opposite end. If the grinder is required, the grinder belt is gently pulled downwards, when it will ride across to touch the moving pulley, gradually pick up the drive like an ordinary fast and loose pulley arrangement, and finally slip over to its proper position. It is stopped by moving the rear half of the belt (travelling upwards), over to the loose pulley. The drive is lost, and the grinder quickly comes to rest. The short time the belt is travelling out of alignment does no harm.

A striking gear was planned when the arrangement was first put up, but has never materialised, as it has proved quick and simple to move the belt by hand. The belt is one of the cotton variety with sewn ends. If the belt had metal fasteners, a striking gear would certainly be used, as it would be asking for trouble to touch such a belt while in motion.

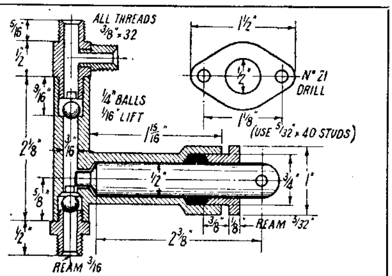
The pulleys on the original are of wood, and as the loose pulley gets relatively little work to do, no special provision was made for oiling it.

The arrangement can be adapted to suit any position of the motor, whether it is above, behind or below the grinder.

Feed Pump for "Maid of Kent"

by "L.B.S.C."

ONE of the most heartbreaking jobs your humble servant ever hit up against in the business of scheming out the details of a little locomotive with inside cylinders and link motion, is the provision of a boiler feed pump. It was one of the tightest squeezes that I ever accomplished in over half-a-century's personal locomotive building, when I fitted a proper Stroudley crosshead pump to my single-wheeler "Grosvenor." Naturally, I knew how the big ones were fitted, "upside down and backwards," in a manner of speaking (the pumps weren't !), but there is a mighty big difference between 4 ft. 8½ in. gauge and 3½ in. ditto. On the old girl herself, there was only about ½ in. clearance between the pump barrel and the connecting-rod ; it couldn't be made any greater, because the pump-ram was screwed into the end of the slipper-block at the side of the crosshead, and this block ran in a channel-shaped guide-bar. My little one is exactly the same, and as my pump-barrel had to be bigger in diameter than "scale" size, to give it the necessary strength, there is only a few thousandths clearance between the connecting-rod and the barrel. If I started specifying that sort of thing for engines described in these notes, the fat would be in the fire, with knobs on, as the kiddies would say !



Section of pump

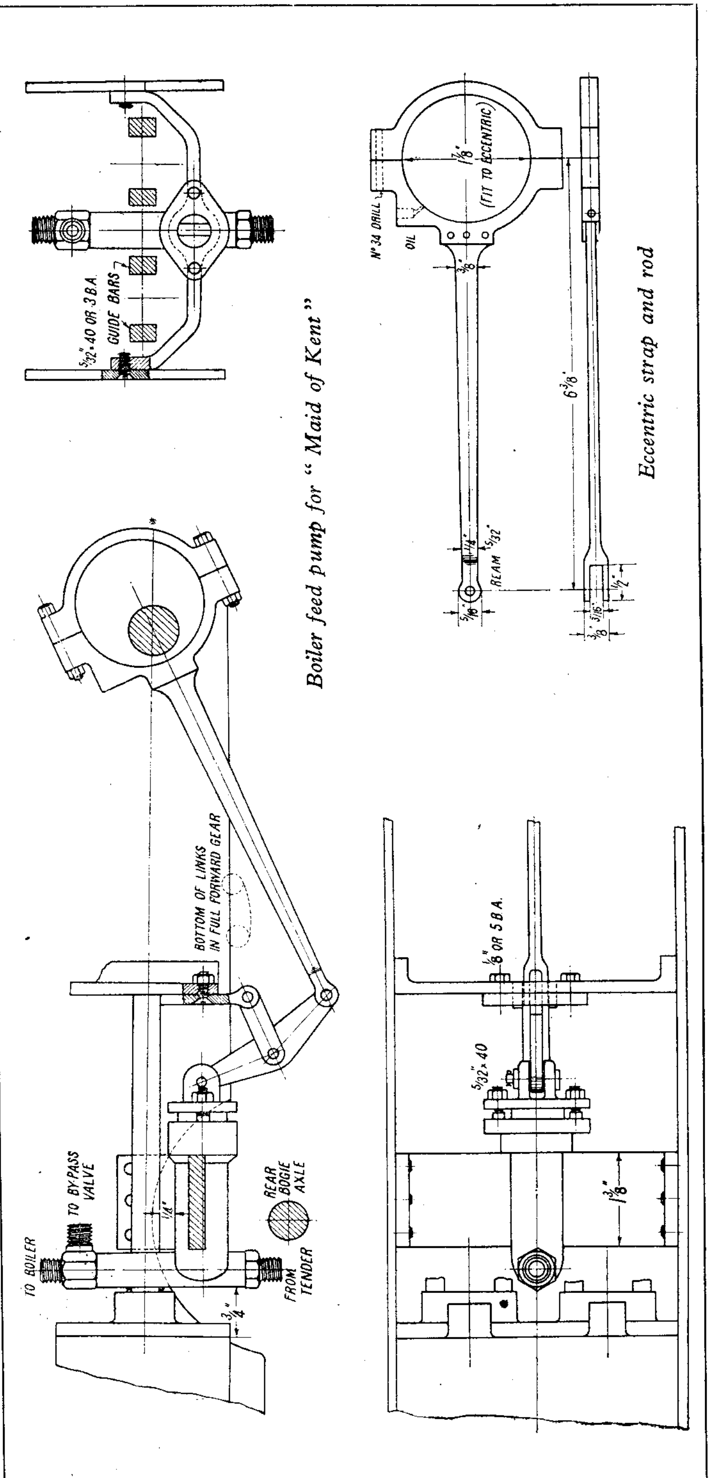
As a matter of fact, I *did* consider the fitting of a crosshead pump to the "Maid" when first tentatively getting out the specification ; but she hasn't channel guide-bars, for a start, so the ram could not have been screwed into the crosshead slide-block. A drop-arm could have been brazed to one of the crossheads, and a long-barrelled pump just about squeezed in between the connecting-rod and the side frames, a little below the centre-line of motion ; but this would have necessitated cutting away the side of the motion-plate to clear the pump, and weakening it. It would have been too far off centre to drop the whole bag of tricks below the motion plate, as the pump would then have been below frame level, and would have needed a deep and long lug to fix it in place.

It seemed that the only solution was to arrange the pump to be driven from an eccentric between those of the link motion, same as "Maisie" ; but on that engine, there was plenty of room between the links, as she had outside cylinders. Not only has the "Maid" inside cylinders, but the valve-gear is necessarily all bunched up in the middle ; and when in full forward gear, the lower ends of the expansion links are below the bottom of the motion-plate, so "Maisie's" pump was ruled out of court in its original state. To tell you the honest truth, I was in two minds to "can" the pump altogether (I shall, if I can possibly build a "Maid" for myself) and rely on the injectors, fitting two of them, as in full size. Injectors are perfectly reliable as long as they are kept clean ; "Jeanie Deans" and "Olga" have injectors only, and I very seldom use the pumps on the other engines. But the policy of "take it or leave it" doesn't appeal to your humble servant in the slightest, I try to do my best for all ; and as I had numerous requests from followers of our craft who shy at drilling weeny-weeny holes, asking for a pump to be specified, there was no alternative but to go ahead and find some solution to the problem, which I did in the following manner.

How the Problem was Solved

Well, I pinned a sheet of tracing paper over my drawing of the valve-gear, and started in to find out where to put the confounded pump, so that the eccentric-rod would miss the link-motion when the links were in full forward gear ; but do you think I could find it ? Not on your life ! I tried an inclined arrangement like "Maisie," and found that the suction-valve union fouled the rails, if the eccentric-rod remained straight ; also, the leverage would soon have wrenched the bracket clean off the motion-plate. I tried the pump in umpteen different positions, with the barrel at all sorts of angles, and every one needed a set-over eccentric-rod, and looked like a botched-up job ; but that sort of thing won't do for old Curly, and I'd be ashamed to offer anything of the sort to followers of these notes. At last, I decided to put a horizontal pump under the guide bars, and devise some means of driving it without using a bent eccentric-rod ; so I made the fresh drawing of the pump, and by the time I had finished, was so browned off that I took one of the engines out on the little railway for a "break" and a breath of fresh air.

They say that a certain gentleman who is reputed to be adorned with horns and a tail, looks after his special favourites. Incidentally, I repaired my old working shoes with a couple of strips of scrap leather belting on each sole, and as it was narrow stuff, it left a gap about ¼ in. wide down the middle ; so that my foot-



Boiler feed pump for "Maid of Kent"

Eccentric strap and rod

prints would have got me hanged, drawn and quartered way back in the middle ages, as they looked exactly as though made by something associated with the nether regions—a "cloven hoof!" Anyway, the water in the boiler was low, as the tender had run dry when finishing the previous run, and I didn't fill it up again; so after lighting the fire, I proceeded to put a drop in with the hand pump. Then the grey matter stirred, and I thought what a prize chump I am! This pump is lever-operated, works perfectly, and the tail end of an eccentric-rod would waggle the lever as easily as I am waggling it with my fingers. When the trip was over, I went back to my drawing-board, put the idea into practice, and here you see the result.

The pump-body and valve-box are cast complete with side "wings" of flanges for attachment to the main frames above the rear bogie-wheels, and the pump is of the correct "internal gland" pattern, with an oval studded gland. It is perfectly accessible for adjustment of the gland nuts. A bracket is bolted to the front of the motion-plate, and carries a slotted anchor-link, in the slot of which is mounted a boomerang-shaped double-armed lever, with arms of equal length. The upper end of this engages with the gudgeon-pin in the pump ram, working in the usual slot; the lower end is operated by the forked end of a long, straight eccentric-rod worked by the centre eccentric, the rod just nicely clearing the expansion-links and back-gear eccentric-rod forks in their lowest position. The anchor-link allows for the slight vertical movement of the double-armed lever, necessitated by the pump ram moving in a straight line. This arrangement

kills two birds with one shot, as the pin for driving the rod to operate the ratchet lever of the mechanical lubricator, can be screwed into the side of the "boomerang" lever, at the exact position to give the amount of movement needed for the ratchet gear.

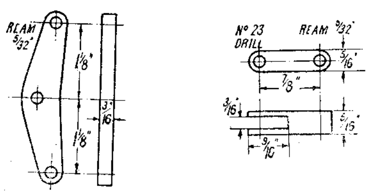
How to Machine the Pump Casting

The fact of the pump-barrel having similar adornments to those of a crow at either side of it, need make no difference to the machining of the casting; just keep your fingers clear of the wings when they start to fly. Grip the bottom of the valve-box in the three-jaw, and set the outer end to run truly; then face, centre, and put a No. 14 drill clean through. Open out to about 7/16 in. depth with 11/32-in. drill, and bottom with with a D-bit of similar size, to 9/16 in. depth; slightly countersink the end, and tap $\frac{3}{8}$ in. by 32. Ream the entrance of the hole at the bottom, with a $\frac{3}{16}$-in. parallel reamer. Chuck a stub of brass rod not less than $\frac{1}{2}$ in. diameter, in the three-jaw; turn down about $\frac{1}{4}$ in. of it to $\frac{3}{8}$ in. diameter, and screw it $\frac{3}{8}$ in. by 32. Screw the machined end of the valve-box on it, then face off the other end, drill to $\frac{3}{8}$ in. depth with 11/32-in. drill, slightly countersink the end, and tap $\frac{3}{8}$ in. by 32. Skim off any burr.

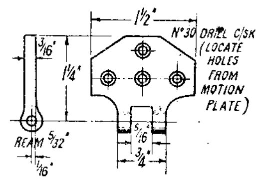
Chuck the casting by the piece provided opposite the barrel, and set the end to run truly. Beginners note, castings are fairly soft, and a gentle tap with a lead hammer will usually bring a recalcitrant member into the path of truth and virtue, without causing any discomfort to the lathe mandrel. Face the end, centre, and drill right through into the valve-box with $\frac{1}{4}$-in. drill; open out to $1\frac{7}{8}$ in. depth with $\frac{1}{2}$-in. drill, and again to $\frac{1}{2}$ in. depth with $\frac{3}{4}$-in. drill. If you have not got one that size, set a boring-tool in the slide-rest, and bore the last bit. Saw off the chucking-piece and clean up with a file; then file or mill the tips of the wings, so that they fit snugly between the frames, like the motion-plate.

If a casting isn't provided for the top cover of the valve-box, seat a $\frac{1}{4}$-in. rustless steel ball on the hole with the usual hammer-and-brass-rod proceeding, and take the depth from the ball to the top of box. Chuck a bit of $\frac{1}{2}$-in. hexagon brass rod in three-jaw, face the end and turn down to $\frac{3}{8}$ in. diameter, a length equal to about 1/32 in. less than the depth just measured; screw it $\frac{3}{8}$ in. by 32. Part off at $1\frac{1}{8}$ in. from the end. Reverse in chuck, centre deeply, and drill right through with $\frac{3}{16}$-in. drill. Turn down $\frac{5}{16}$ in. of the end to $\frac{3}{8}$ in. diameter, and screw $\frac{3}{8}$ in. by 32. Cross-nick the bottom end, and screw in temporarily, noting which facet of the hexagon lines up with the pump barrel. Centre-pop the middle of this, and put a $\frac{1}{4}$-in. drill in. Chuck a bit of $\frac{3}{8}$-in. round brass rod, face, centre deeply, and drill about $\frac{5}{8}$ in. depth with No. 22 or 5/32-in. drill. Screw $\frac{5}{16}$ in. of the outside, $\frac{3}{8}$ in. by 32. Part off at $\frac{5}{8}$ in. from the end, reverse in chuck, and turn $\frac{1}{8}$ in. of the other end to a tight fit in the $\frac{1}{4}$-in. hole in the cap. Squeeze it in, and silver-solder it; merely apply a little wet flux, heat to dull red, and touch the joint with a strip of "Easyflo" or No. 1 (best) grade silver-solder. Pickle, wash and clean up.

Drop a $\frac{1}{4}$-in. ball in the other end, take depth, then chuck the $\frac{1}{2}$-in. hexagon rod again, face the end, and turn down to $\frac{3}{8}$ in. diameter, a length equal to the depth, screwing $\frac{3}{8}$ in by 32. Part off at 11/16 in. from the end. Reverse in chuck, and machine up a union-screw on the other end, exactly as described above. Reverse in chuck once more; poke a $\frac{3}{16}$-in. parallel reamer clean through, then skim $\frac{1}{32}$ in. off the end, to form a true seating for the ball. Put a $\frac{1}{4}$-in. ball on it, give it the usual crack to seat it, then assemble as shown in the sketch. Don't forget to nick the central passage, as shown in the section. If castings are provided for these little parts, they can be machined in the same way, but no silver-soldering will be needed for the by-pass nipple, as it will be cast on, and there will be a chucking-piece opposite it, to hold in the chuck whilst the nipple is being turned, screwed, and drilled. It is afterwards cut off.



Rocker and anchor link



Bracket for fulcrum pin

If the oval gland hasn't a chucking-piece, chuck it in the four-jaw, holding by the flange, with the spigot running truly. Face, centre, and drill through with $\frac{1}{8}$-in. drill, following up with $\frac{1}{2}$ in., then turn the spigot to a nice sliding fit in the end of the pump barrel. Next, chuck in three jaw, holding by the spigot, and face the flange; drill two No. 21 holes in this, as shown, at $1\frac{1}{8}$ in. centres. Put the gland temporarily in position in the end of the barrel, run the No. 21 drill in, making countersinks on the barrel flange; remove gland, open the holes with No. 30 drill, and tap 5/32 in. by 40. Make a couple of studs from 5/32-in. rustless steel or bronze (they will probably get wet!) same as spring-pins for axleboxes, and fit a couple of nuts made from $\frac{1}{4}$-in. hexagon brass rod.

A piece of $\frac{1}{2}$-in. ground rustless steel, or drawn bronze rod, should slide nicely in the $\frac{1}{2}$-in. hole in gland and barrel, and will do for the pump ram or plunger. Chuck in three-jaw, and turn down the end for $\frac{1}{4}$ in. length to 7/32 in. diameter, to form "Curly's patent anti-airlock

pin" (the best investment against pump failures that I know of—honest, not "hot air"!), bevelling as shown, to match the angle of the drill used in opening up the barrel. Part off at $2\frac{5}{8}$ in. from the shoulder. Drill a No. 23 cross-hole $\frac{1}{4}$ in. from the end; then slot the end $\frac{3}{16}$ in. wide and $\frac{5}{8}$ in. deep, as described for valve-gear forks, finally rounding off the end, and reaming the cross-hole with 5/32-in. parallel reamer. Pack the gland with a few strands of unravelled hydraulic pump packing, if available (all engineers' stores sell it, especially in seaport towns) or failing that, graphited yarn; and be mighty careful to screw the two nuts evenly, so that the gland does not go in skew-whiff, and bind on the ram. You should be able to operate the ram with your fingers.

At $1\frac{1}{2}$ in. behind the cylinder casting, and level with the tops of the guide-bars, drill a No. 21 hole, and two more in line with it at $\frac{1}{2}$ in. centres; you can see them in the assembly drawing, looking like three "Chads." Countersink on the outside, as the sandboxes on the finished job will prevent projecting heads being used. Now take off the bogie, by just unscrewing the nut on the bogie-pin, and push up the pump into place, setting it so that the valve-box is $\frac{3}{4}$ in. behind the cylinder cover, and the top line of the pump barrel is $\frac{1}{4}$ in. below the bottom of the guide-bars, as shown in the elevation drawing. Poke the No. 21 drill through the holes in the frame, making countersinks on the wing flanges, follow up with No. 30 drill, tap 5/32 in. by 40, and put six countersunk screws in. This pitch and size is not a commercial line at the moment, but I understand that two of our advertisers are about to instal capstan lathes, and will be able to supply all the special-thread screws which may be needed. For the time being, make your own, from $\frac{5}{16}$-in. round steel rod in the present instance.

Very little need be added about the drive. The eccentric-strap and rod are made the same way as those for the link-motion, but to the sizes given in the illustration; the eccentric-rod, when the whole issue is erected, goes between the two back-gear eccentric-rods, the strap being fitted to the middle tumbler. The "boomerang" lever is filed up from $\frac{3}{16}$-in. steel plate, or a bit of $\frac{3}{16}$-in. by $\frac{5}{8}$-in. flat bar; the eyes should be case-hardened. The anchor link is made from a piece of $\frac{5}{16}$-in. sq. steel, drilled No. 23 at $\frac{7}{8}$ in. centres, and slotted at one end, the slot being $\frac{3}{16}$-in. wide and 9/16 in. long. Round off the ends, and ream the hole in the solid end 5/32 in. The bracket holding the anchor-link is a casting; file out the jaws so that the anchor-link fits nicely between them, then put a No. 23 drill through both the bosses, and ream 5/32 in. Hold the bracket against the motion-plate in position shown, and mark off the holes on it by using a bent scriber put through those in the motion plate; or better still, take out the motion-plate altogether, and temporarily clamp the bracket to it, drilling the holes right through, countersinking those in the bracket, and fixing by countersunk screws and nuts, putting an extra one at the top for added strength.

To assemble the drive, put the "boomerang" lever in the slot in the anchor link and drive or squeeze a 5/32-in. silver-steel pin through the lot; then put the link in the slot in the bracket, with a 5/32-in. silver-steel pin, reduced and nutted both ends, through bracket lugs and the solid end of the link. The eccentric-rod is pinned to the bottom of the "boomerang" lever by a similar pin, made as described for the valve-gear; finally, put the upper end of the "boomerang" lever in the slot in the pump-ram, and either pin it with another nutted pin as above, or turn up a 5/32-in. plain pin with $\frac{1}{4}$ in. flat head, and secure it with a washer and a weeny split pin as shown in the plan view.

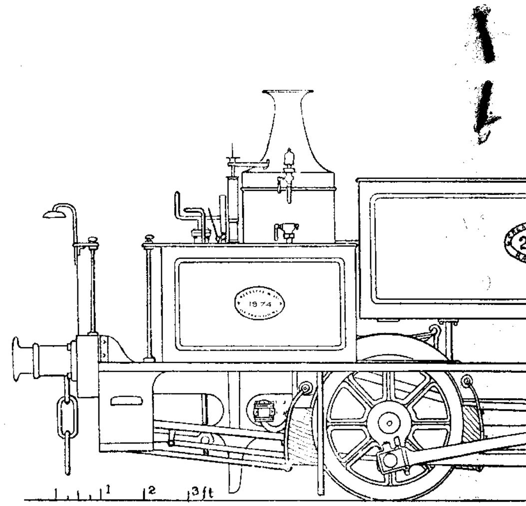
Electrification of Lickey Incline

A LETTER from Mr. A. P. Goodman, of Derby, refers to the fact that "L.B.S.C." recently advocated the electrification of the Lickey Incline on economic grounds. He goes on to state that the size of a generating station is dependent upon the height of the load peaks and not upon the average load; therefore, the required station at Lickey would be considerable, and that it would be required at intervals for a short time only, spending the rest of the time on very light load or no load at all. This is a most uneconomical method of working, especially since, in addition to the above, at least one locomotive would have to be provided, and both up and down tracks would have to be provided with a system of current collection. Mr. Goodman suggests that to propel a train of a total weight of 550 tons up the incline at 30 m.p.h. would require an expenditure of about 2,250 kW, and this could quite satisfactorily be provided by diesel-electric traction, which would appear to be far more economical. I would make a few comments of my own on all this. First, I agree generally with Mr. Goodman's remarks; a complete generating station, electric conductors and a locomotive for working two miles of 1-in-38 gradient seems hardly a sound proposition. Secondly, however, I am not so sure that "L.B.S.C." visualised such a scheme when he wrote his comment. It is possible that a supply of electricity could be taken from the grid without involving the building and operating of a separate generating station. But I sometimes wonder why many people think of railway electrification in terms of power-houses, conductor-rails and all the rest of the paraphernalia that go with electric railways as we know them. There is little or nothing to be said against this system for suburban traffic; but for main-line requirements, it seems very cumbersome. I think that present developments show that when the time comes for replacing the steam locomotive, the replacement will be a self-contained prime-mover capable of generating and using its own power, just as the steam locomotive possesses these features. Such a machine seems to offer the most convenient and economical means of operating fast, long-distance traffic, and heavy, local hauls.—J.N.M.

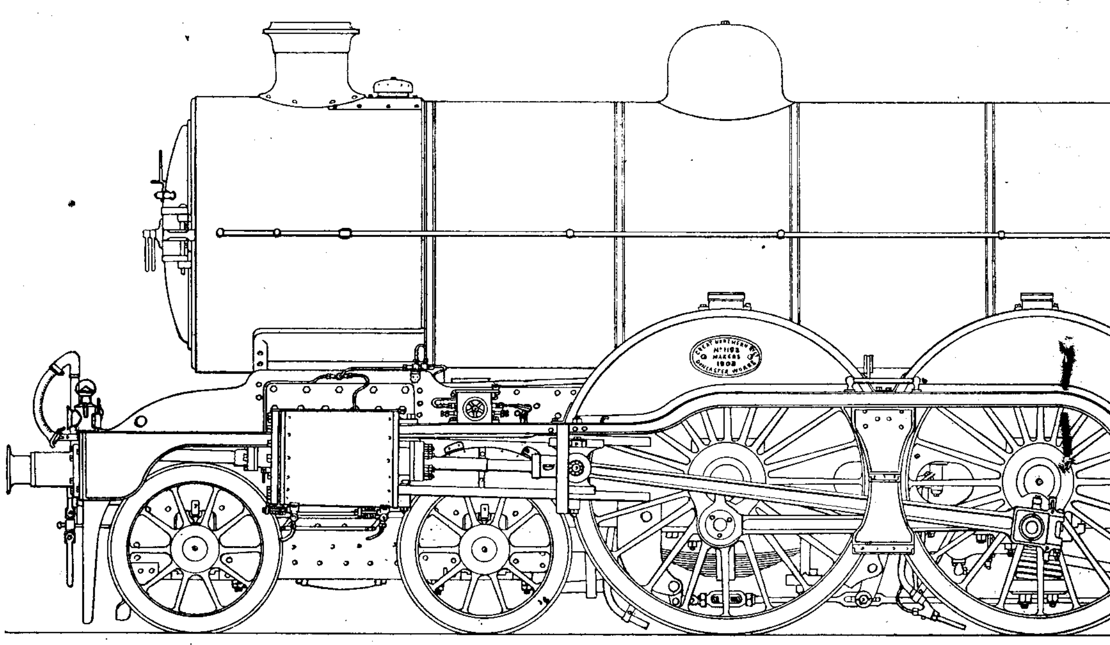
LOCOMOTIVES WORTH MO

No. 26—L.N.E. Rail

SIX years after Craven had built the little four-wheeled saddle-tank engine at Brighton which I described in my last article, two locomotives were purchased by the Great Eastern Railway from Messrs. Neilson & Co., Glasgow, which bore, in many ways, a remarkable resemblance to the yellow No. 400. One cannot help feeling that these G.E.R. engines (Nos. 209 and 210) would make charming models, especially if contrasted with one of the L.B.S.C. Railway design. They were what I dub " Contractor's engines " in type, and their little 3 ft. 6 in. wheels with cross-section spokes, and shapely 5 ft. 5 in. connecting-rods looked very pretty indeed when revolving slowly during shunting operations in the various goods yards where they were employed. Just previous to their delivery at Stratford from the North, that fine engineer, William Adams, had taken charge of the locomotives of the G.E. Railway ; but, so far, he had had no time to produce any engines of his own design. It is not surprising, therefore, that No. 209 bore some traces of the previous Stratford chief, the famous Mr. Archibald Sinclair. The most prominent of these were : the green paint with black lining bands, the stove-pipe chimney with its double beading at the top, and the curious method of suspending the headlamps by their handles, which



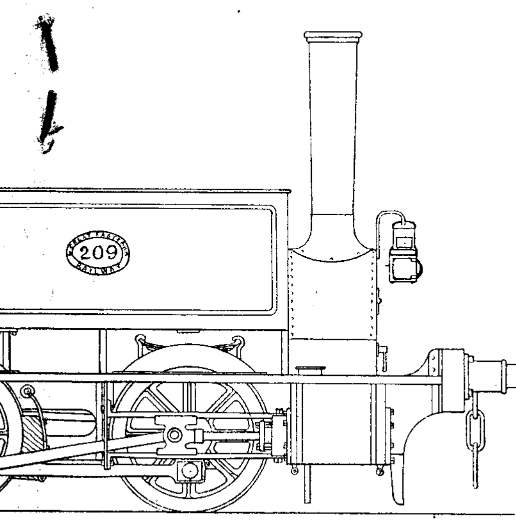
This G.E.R. saddle tank would



Ivatt's Atlantic—one of the most successful of all designs of l

MODELLING by F. C. Hambleton

Railway, No. 4444



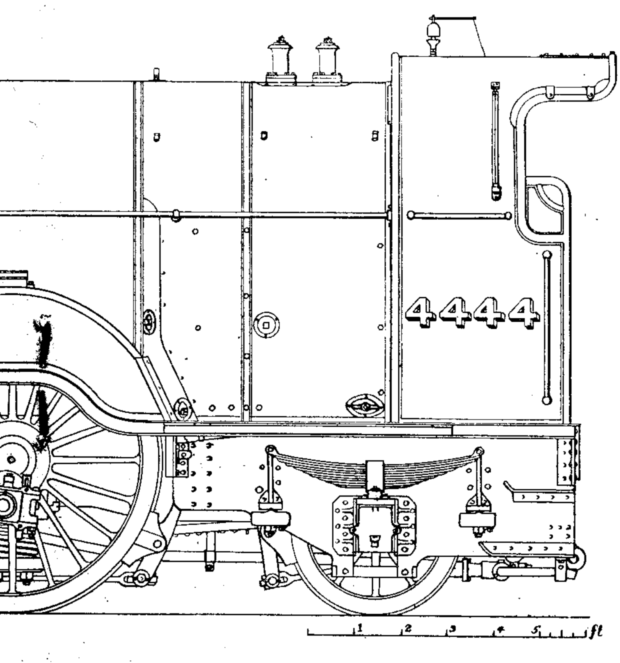
ak would make a charming little model

rested in a kind of spoon-shaped lamp bracket.

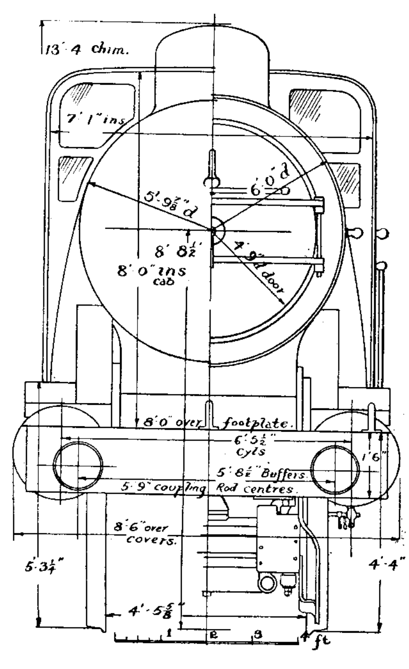
The saddle-tanks were flat across the top—an unusual feature, but otherwise many of the details were much like those of the Brighton engine—even including the Ramsbottom type spring-hangers, as a comparison of the two drawings will show. The cylinders were 12 in. diameter by 20 in. stroke, working at 120 lb. The wheelbase was 5 ft. 9 in. and the leading overhang was 5 ft. 10 in. and at the trailing end no less than 6 ft. 8 in! The boiler measured 3 ft. 5 in. in diameter, with a length of 8 ft. 8 in., whilst the outside firebox was 3 ft. long. The engines weighed only 17 tons 3 cwt. in working order, the leading wheels taking 8 tons 3 cwt. of the load.

Well, there they were, the perky little imps, with shining brass safety-valve covers, slender chimneys, and, no doubt, one of the most fascinating of the miniature "four-wheelers."

But it was not only the diminutive "Contractors' Engines" that displayed that particularly pleasing arrangement of connecting-rod with the coupling-rod tucked away behind. I shall never forget my thrill on first seeing the same arrangement on a truly huge locomotive—one of the world-famous Ivatt Atlantics. But now instead of slowly puffing around a goods yard

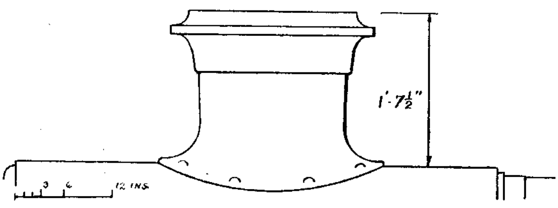


igns of locomotive



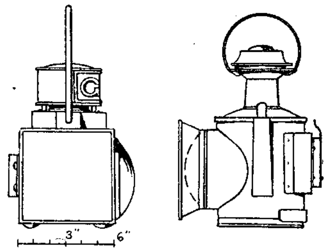
A monster engine, indeed!

this monster came roaring through Hitchin Station at incredible speed, all the rods flashing round with terrific rapidity. Oh! but what a wonderful engine! Yes, indeed! so wonderful, and their exploits so well-known, that it is quite needless to speak of them here. As they got older they kept putting up finer and finer performances, thanks to the introduction of superheating and other modernising touches. It reminds one of the similar case of the old Cunard liner *Mauretania*, when, fitted to burn oil instead of coal, and with new propellers, she used to amuse herself by beating her own marvellous records! Flighty old thing!



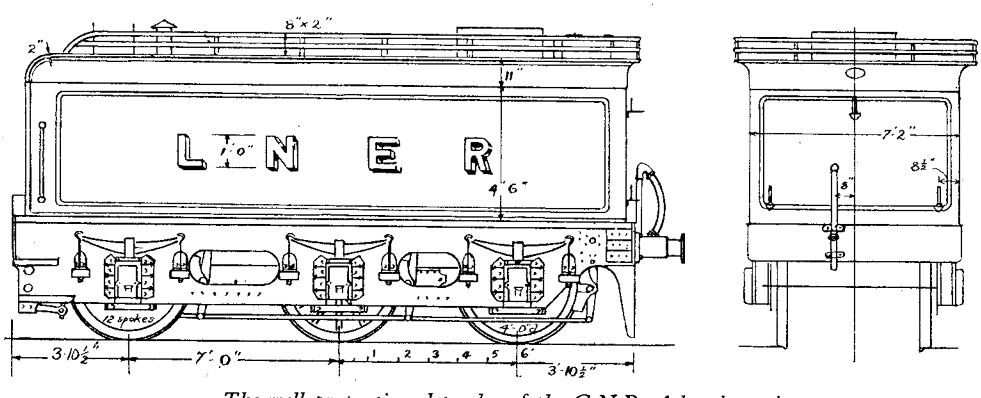
G.N.R. Atlantic chimney—a descendant of the old Stirling pattern

I mentioned the curious Sinclair headlamps. Well, a small point of interest is worth noting in connection with No. 4444. When No. 1444 (as No. 4444 was originally, when built in 1908) she carried a set of black square headlamps of Patrick Stirling's pattern, as indeed, all G.N. Railway engines did during Ivatt's tenure of office. When Sir Nigel Gresley succeeded to the command at Doncaster, superheating, mechanical lubrication, and piston-valves became very much the order of the day, and amongst these and other items a change of headlamps took place. The newcomers were cylindrical, with an inner case, which could be revolved to give either a white, red or purple light as required. These lamps were painted white, and fitted with a prominent lens-hood. They have now vanished, but, of course, No. 4444 carried a set in her later days, and it is of interest to record that *Mallard* also carried one over each of her buffers when she made her world speed record. Thus these lamps can claim the proud distinction of having travelled faster than any other type! What a contrast little G.E.R. 209 would make with mighty 4444! and yet—well, they both possessed the same charm in their respective ways that every good loco-



The Stirling and Gresley headlamps; note the prominent brass "G.N.R." label on the former

modeller feels and loves so well! One of my last runs behind 4444 was from Cambridge. It was a hot summer afternoon—one of those golden days when the exhaust steam from the chimney was quite invisible, and all things seemed in tune. How we got away from the little wayside stations! Wonderful acceleration — so great that one felt as if some giant was taking one firmly round the waist and hurling one through space! And then the typical sound of the outside rods—all the Atlantics had it—a dull ring as of mighty gear-wheels gently engaging with each other, and above all the funny little whistle, a stifled note blown away by the rush of the wind—such a small voice from such a giant! Unforgettable moments! Unforgettable engines! And, now, which one shall we model first?



The well-proportioned tender of the G.N.R. Atlantic engines

Dimensions:

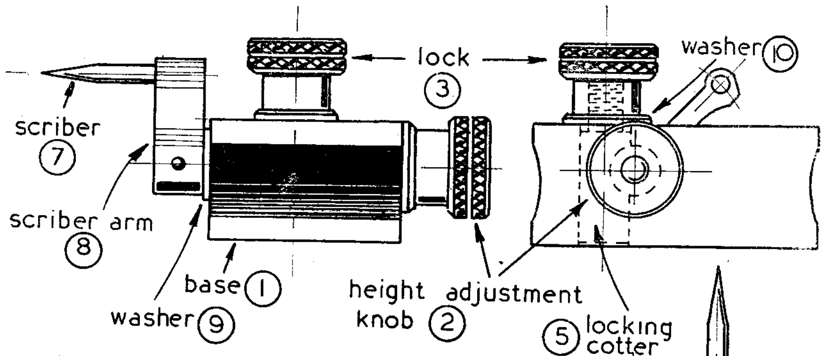
Diameter of wheels: bogie, 3 ft. 8 in.; driving, 6 ft. 8 in.; trailing, 3 ft. 8 in. Wheelbase: bogie, 6 ft. 3 in.; driving, 6 ft. 10 in.; trailing, 8 ft. 0 in. Total wheelbase, 26 ft. 4 in. Leading overhang, 2 ft. 5 in.; trailing overhang, 4 ft. 3¾ in.. Wheelbase of engine and tender, 49 ft. 1¾ in. Overall length, 58 ft. 6 in. Cylinders, 20 in. by 24 in. stroke. Length of boiler, 15 ft. 6½ in.

IN THE WORKSHOP

by "Duplex"

*13—The Surface Gauge

AS a full-sized surface gauge was at times found to be unduly cumbersome for small work, the writers designed and made the dwarf gauge, illustrated in Fig. 1, and the following drawings, which has a maximum scriber height of 1 in.



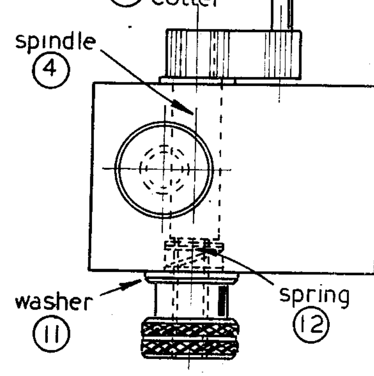


Fig. 1

The scriber point is set by rotating the scriber arm by the attached knurled finger-nut, after which the gauge is locked by means of the knurled nut shown on the upper surface of the base block.

As this is an interesting and useful piece of work, and as there are, we know, many who prefer to make their own small tools, we are giving full drawings and instructions for making up this small gauge. If the work is carefully carried out and the gauge as a whole is well finished, it should, at least, suggest some connection with the products of Messrs. Starrett, than which no higher recommendation can be given.

The base block was cut to a length of 1$\frac{1}{2}$ in. from a $\frac{5}{8}$-in. by 1-in. mild-steel bar. The under surface was first lightly filed and then scraped, until it everywhere made even contact with the surface plate. From this datum surface, the sides, ends, and upper surface of the block were scraped true.

Although the preliminary work can be done by filing, it will generally be found quicker to true the sides and ends by milling in the lathe.

For this purpose, the block can be either secured to the top slide by means of the tool clamp, or held in the machine vice attached to the vertical slide.

One of the two long sides of the block is then set at right-angles to the lathe axis by means of a straight-edge resting against the front face of the self-centring chuck, as illustrated in a previous article; the jaws should be opened sufficiently to allow the straight-edge to make contact right across the chuck face. When squaring the ends of a number of bars, we use a fence which is secured to the top slide and set parallel with the lathe axis; this saves much time when repetition work is undertaken.

The machining is carried out with a fly-cutter of the pattern illustrated in the article in the January 29th issue.

If a multi-tooth milling cutter is used, tool marks will probably be formed, their depth depending on the sharpness of the cutting edges and the rigidity of the lathe.

When a fly-cutter is used, its edge should be carefully stoned to a high finish, and its sharpness should be such that it will readily cut the skin if due care is not taken when setting components in the lathe.

With a properly sharpened cutter-bit we have found that even aluminium alloys can be machined to an almost polished surface devoid of unsightly tool marks. Only light cuts should be taken when fly-cutting and, if possible, the work should

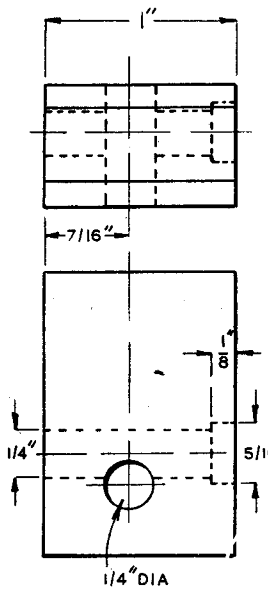
**Continued from page* 586, "*M.E.*," *June* 3, 1948.

be traversed by means of the cross-slide power feed.

After the first side has been machined, the second long side is set up and machined in the same way. The ends of the block are set square by applying the stock of the try-square to the chuck face and the blade of the square to one of the previously machined sides.

As will be seen in the drawings, the ends of the block are hollowed out; this is to provide a good finger-hold, but it also serves to improve the appearance of the work and to bring it into line with standard commercial products.

This hollowing to a depth of some 3/32 in. can, again, best be carried out by using a fly-cutter, mounted in a boring bar such as the Nulok and set to a radius of about $\frac{3}{8}$ in.; in this case, a fine feed is given to the work by means of the lathe power sliding motion.



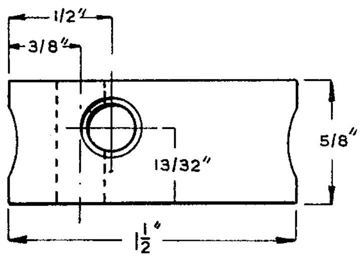


Fig. 2 (part No. 1)

May we point out to beginners that Fig. 1 is a general arrangement drawing which serves to indicate the appearance of the work, and in addition, the component parts are numbered so that they can be readily identified by the same numbers in all subsequent drawings.

The next step is to mark out the block for drilling the holes to receive the scriber spindle and its locking cotter.

When doing this, Fig. 2 should be consulted to obtain the necessary dimensions, whilst Fig. 1 will show the arrangement of the parts when in place and the purpose of the machining operations.

After the front face and the upper surface of the block have been painted with marking fluid, the scriber of the surface gauge is set to 13/32 in., and the horizontal centre line of the spindle is scribed with the work resting on the surface plate; the vertical cross-centre line is then scribed with the scriber reset to $\frac{1}{2}$ in. and the block standing on its end. With the same scriber setting and with the block standing on its side, the centre line of the cotter hole is marked out on the top face. The cross-centre line of the cotter hole is scribed with the scriber reset to $\frac{3}{8}$ in. and the block standing on end.

The cotter hole is first drilled for a short distance with a centre drill, and this is followed by a letter D drill carried right through the block. The hole is finished to size with a $\frac{1}{4}$-in. reamer.

The cotter—identify this part in the general arrangement drawing as No. 5 and refer to 5 in Fig. 3—is turned from brass or bronze rod to the dimensions shown and so that it is a light press fit in its hole in the block. The reason for this is to give it a firm hold while it is being cross-drilled during the boring of the spindle bearing hole.

After the cotter has been turned and before it is parted off, the thread should be cut by means of a die mounted in a holder in the tailstock.

When in position, the lower end of the cotter should be just short of the under surface of the block.

With the cotter secured in place, the spindle hole is now drilled with a letter D drill, and the bore is finished to size with a $\frac{1}{4}$-in. reamer.

The cotter is then carefully driven out and, when lightly held by its threaded portion in the chuck of the drilling machine, it is given a few strokes with a fine file to make it an easy push-fit in its hole.

To complete the machining of the base block, the outer portion of the spindle hole is counterbored to $\frac{5}{16}$ in. diameter for a depth of $\frac{1}{8}$ in. to form a housing for the spring.

The turning and threading of the spindle is a straightforward job and requires no explanation, but it should be noted that, at the right-hand end, the diameter of the central portion is reduced by five-thousandths of an inch to accommodate the particular spring used, although this may not be necessary in every case.

The scriber arm should next be tackled; this is cut out from a piece of $\frac{1}{4}$-in. mild-steel, and then filed to shape in accordance with the drawing. The large hole is drilled No. 18, and when the corresponding end of the spindle has been lightly polished in the drilling machine with a fine file, the two parts should mate with a light press fit. For additional security, a small taper pin is fitted with the aid of a 6/0 taper reamer, as described in a previous article.

As will be seen in the drawing, the small end of the scriber arm is drilled No. 54 and then tapped 10 B.A. for the two grub-screws used to secure the scriber in its 3/32 in. diameter hole.

The two finger-nuts, parts 2 and 3, are made in accordance with the drawing and should present no difficulty, but great care should be taken to cut the knurling really well, as described in a previous article devoted to the subject, for faulty knurling is always an eyesore, particularly when the rest of the work is well finished.

As a practical point, the quickest way to make the two finger-nuts is to knurl the whole length of material required at one operation, instead of doing this in two stages as the individual nuts are machined.

It should be noted that part No. 2 is fitted with a 10-B.A. grub-screw to secure it to the threaded end of the spindle after the frictional contact has been adjusted; this screw should be fitted in the groove dividing the two sections of the knurling.

With regard to the three washers shown as parts 9, 10 and 11, these should be specially made, both because they are not of standard size and also for the sake of appearance.

This, again, is straightforward lathe work, and if a two-station back tool post, as previously described, is used to mount a parting and a chamfering tool, the machining can be very quickly carried out. The writers find it very little trouble to make a dozen washers for any special purpose, and when a few washers are being made it is a good plan to make a quantity to store for future use.

The method generally used is to turn a length of round stock, mounted in the self-centring chuck, to the required outside diameter. The correct size of drill is then fed in from the tailstock for a depth sufficient to bore all the washers, and the face of the rod is finish turned and chamfered.

Next, the first washer is parted off to the correct thickness by using the leadscrew index, and these operations are repeated until the required number of washers has been machined.

The short length of spring calls for no special mention, as its only duty is to impose a slight frictional contact to control the scriber arm during adjustment, but it should be noted that both ends of the spring are ground flat on the emery wheel to ensure smooth working.

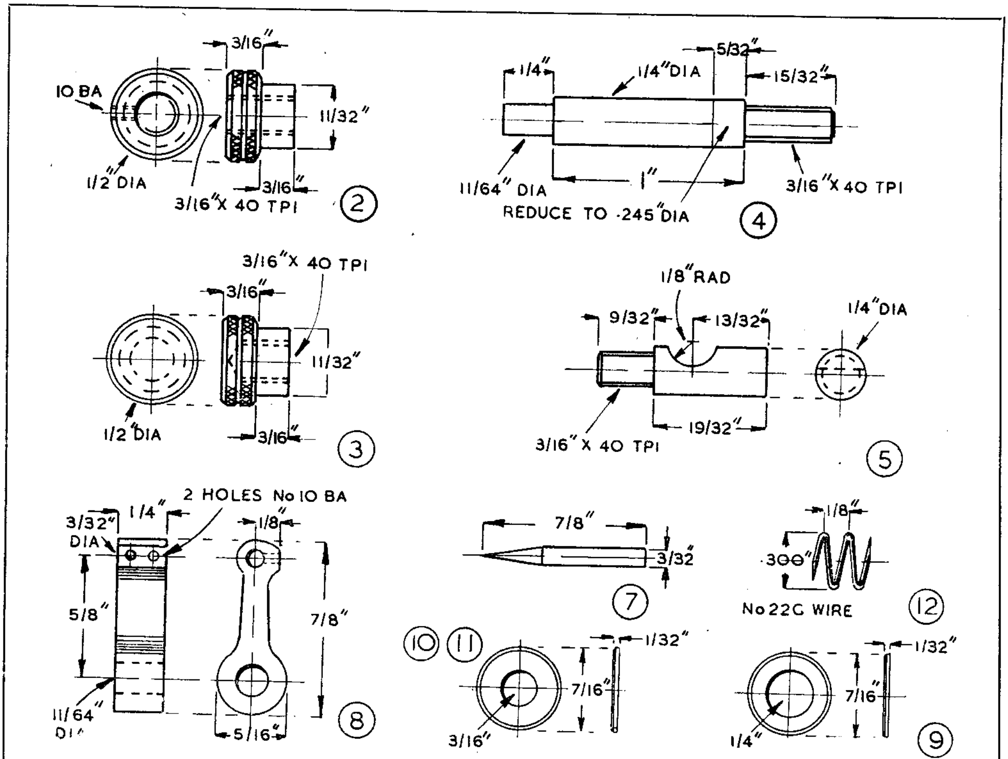


Fig. 3

The only remaining part is the actual scriber; this is made from a piece of silver-steel turned to a fine point and then polished in the drilling machine. When hardening the steel, it is advisable to heat it while carried within a piece of tubing, as this will maintain the heat during transfer to the cooling medium. The scriber should be heated to a cherry red and then quickly dropped into thin machine oil, but if this does not harden it sufficiently it must be reheated and immersed in water. The latter operation may leave the steel rather brittle, and it should, therefore, be tempered to a light straw colour by careful heating on a metal plate and then cooling in water.

Finally, the scriber is mounted in the high-speed drilling machine, and after it has been polished with a piece of worn, fine emery cloth, the point is sharpened as it rotates by using a small oil-stone slip.

As to the general finish, the main consideration

is that this should be equal throughout so that highly finished and poorly finished parts are not assembled together.

The ends of pins and shafts, and also the heads of screws, are easily polished with fine emery cloth while they rotate at high speed in the drilling machine, but the intricate curves of the scriber arm must be hand polished.

A good appearance will be given to the base block if it is hand scraped and the surfaces finished with diagonally crossing scraper marks.

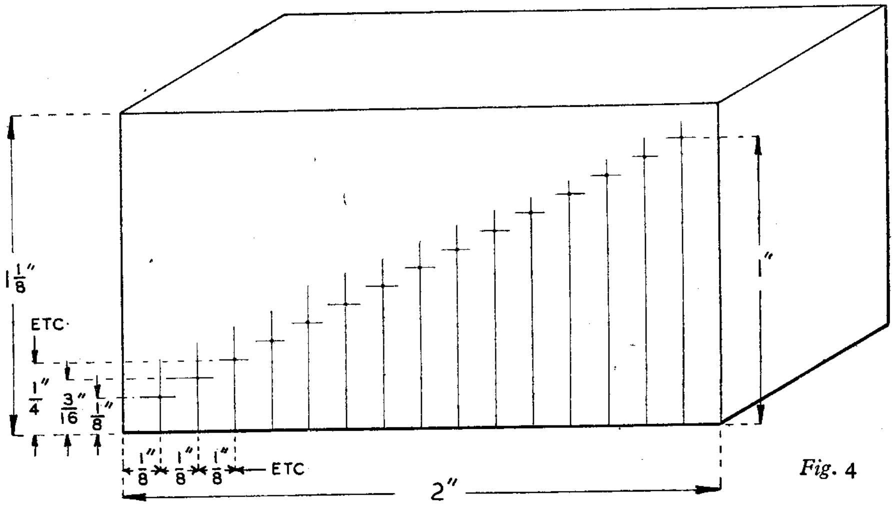


Fig. 4

This scraped finish has the advantage that, in the event of rusting arising from handling, any blemishes of this nature can be readily removed with the scraper, whereas this would be a more difficult matter in the case of a filed finish.

As a finishing touch, the curved surfaces at the ends of the block can be painted with cellulose cycle enamel, and when this is quite dry, the work is rubbed with liquid metal polish to remove the shininess and impart an even gloss-finish to the painted surfaces.

It now only remains to assemble the parts and adjust the frictional control of the scriber arm to make the gauge ready for use.

Height Setting Gauge

A further advantage of this small gauge is that the scriber point can be readily adjusted to the required height by means of an easily made setting block of the pattern illustrated in Fig. 4. As will be seen, this block is provided with a series of holes, and when it is placed on the surface plate the scriber point is set by being engaged with the appropriate hole and the clamp-nut is then locked.

To make the gauge, a piece of cast-iron or mild-steel, $1\frac{1}{8}$ in. sq. and $2\frac{1}{8}$ in. in length is required.

The under surface of the block is scraped flat so that it seats evenly on the surface plate; the front and back faces are also scraped to enable the block to lie flat on the table of the drilling machine while the index holes are being drilled.

In addition, the left-hand end of the block is filed truly square, as it is used as a datum face for marking out.

After the front face has been painted with marking fluid, the jenny calipers are set to $\frac{1}{8}$ in., and a line is scribed $\frac{1}{8}$ in. from the left-hand end of the block; the calipers are then set to $\frac{1}{4}$ in. and another line is scribed. This is repeated at $\frac{1}{8}$-in. intervals until all the fifteen vertical lines have been marked out.

Next, the vertical distances are marked out, starting at $\frac{1}{8}$ in., and increasing by $\frac{1}{16}$ in. each time, until the fifteenth vertical line, previously scribed, is crossed by the 1-in. horizontal line.

Hold the block at eye level to make sure that the points of intersection lie on a straight line; if they do not, any apparent errors must be checked and corrected.

These points of intersection are now carefully centre punched with the aid of a magnifying glass; then check at eye-level again and correct any errors by drawing over the punch marks.

A standard centre drill with an $\frac{1}{8}$-in. shank and a 3/64-in. point is mounted in the high-speed drilling machine, and the holes are drilled with the drilling stop set to impart a slight countersink at the mouths of the holes.

The holes are then deepened to $\frac{1}{4}$ in. with a No. 56 drill to make sure that the scriber point will not bottom in the holes.

The back face of the block is marked out and drilled in a similar manner, except that, in this case, the first hole is drilled 3/32 in. above the base line, and, as before, this dimension is increased by $\frac{1}{16}$ in. for each succeeding hole, making the last 31/32 in. above the base.

To mark the holes and to give a good appearance, $\frac{1}{16}$-in. figure punches may be used. It will be sufficient, as is done in the case of wood-bits, to mark in units only, that is to say multiples of $\frac{1}{16}$ in. are used on the front face: 2 : 3 : 4 .... 16 indicating $\frac{1}{8}$ in. : $\frac{3}{16}$ in.; $\frac{1}{4}$ in. .... 1 in.

To avoid crowding the figures, the intermediate values may be omitted and only the even numbers marked: 2 : 4 : 6 .... 16.

On the back face the 1/32 in. dimensions are marked: 3 : 5 : 7 .... 31, or alternatively 3 : 7 : 11 .... 31.

To finish the gauge, the right-hand end is squared up so as to leave an interval equal to that at the left, and the upper surface is filed to a good finish.

If drilling operations are to be carried out accurately, it is essential that the machine vice used to hold the work on the drilling-machine table should itself be accurately machined.

To test a machine vice, it is placed on the surface-plate and the underside of the base is tested for flatness with the aid of marking

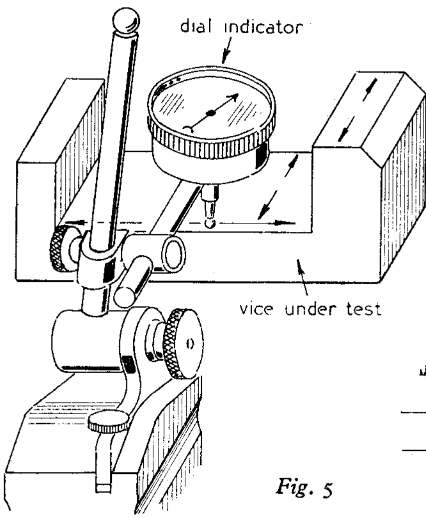


Fig. 5

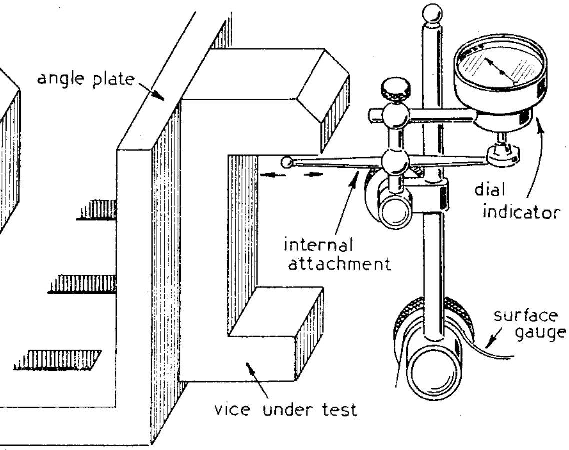


Fig. 6

Using the Test Indicator with the Surface Gauge

The usefulness of the surface gauge can be further increased by mounting a dial-test indicator in place of the scriber.

For this purpose Messrs. Moore and Wright cross-drill the scriber clamp fitted to their surface gauge with a $\frac{1}{4}$ in. diameter hole to carry the arm of a standard test indicator, whilst the clamp supplied with the Starrett indicator is bored $\frac{5}{16}$ in. to fit the spindle of any standard surface gauge.

If the test indicator is used, instead of the curved point of the scriber, for levelling a bar attached to an angle-plate as described in the previous article, an exact measurement can be obtained of the difference in height of the two ends of the bar. Again, when the setting of a component is adjusted by means of packings, the use of the indicator will, in many cases, show at once the exact thickness of the packings required for the final setting.

Those who have had to set heavy pieces of work to run truly when mounted on the lathe face-plate will, no doubt, remember the difficulties caused by the part tending to move under its own weight before the clamping bolts have been fully tightened.

To obviate this, the face-plate can be unshipped and placed horizontally on the bench ; the register pegs of the surface gauge are then kept in contact with the edge of the face-plate while the test indicator is used to locate the work centrally, as in setting work to run truly when held in the four-jaw chuck.

compound ; any irregularities must be removed by scraping until good uniform contact is established.

The test indicator is then mounted on the surface gauge and, as illustrated in Fig. 5, the contact point is applied to the machined surface against which the work normally rests.

For this purpose, it is usually best to remove the movable vice jaw.

The surface gauge is then moved along this surface and any variation of the indicator is noted ; next, the indicator is moved across the surface at several points. If the work surface of the vice is parallel with the base, there will, of course, be no variation of the indicator readings.

The upper surface of the fixed jaw should then be tested in the same way, as this is often used as a reference surface when setting the work.

The angle made by the fixed jaw with the work surface can be tested either with a square or in the manner shown in Fig. 6 ; here, the vice is clamped to an accurate angle-plate and the internal contact point of the indicator is moved across the jaw in the direction indicated by the arrows. Any variation of the indicator will reveal the amount of inaccuracy present.

In the writers' experience a moderately expensive machine vice proved to be grossly inaccurate in all these material particulars, but fortunately this was discovered before any work had been spoilt. The vice in question had to be remachined and hand scraped before it was regarded as fit for use where accurate work was concerned.

*A Radio-Controlled Launch

by R. M. Cooper

AFTER much experiment and consideration, a circuit as shown in Fig. 5 was finally adopted. This consists of two valves, one acting as oscillator at half the output frequency, and the other driven, through frequency-doubling, as a power amplifier.

A Pen 25 valve is used as the oscillator, and is anode grid tuned to operate at 14 megacycles. and a jack plug is provided to enable immediate readings to be taken of the anode current of the power amplifier for alignment purposes.

A switch key is provided for operation, so that impulses can be transmitted, and this was arranged to stay on in one direction to allow for adjustments before a run, and to be spring controlled in the other direction, for fast operation, whilst the whole case can be closed up for convenient transport to the pool.

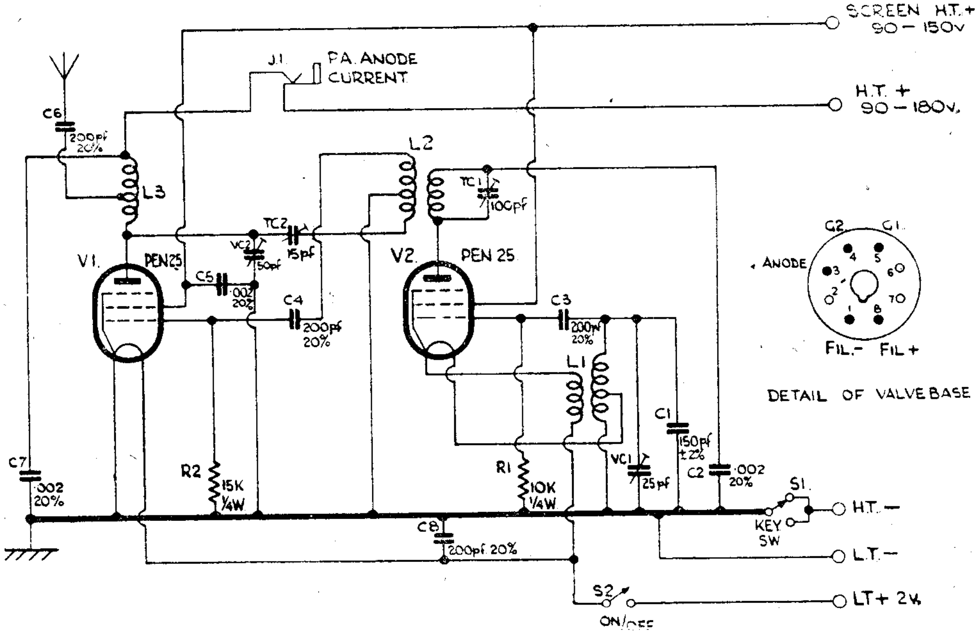


Fig. 5. Circuit diagram of control transmitter

A coupling coil tuned to the second harmonic, i.e. 28 megacycles, drives the other Pen 25 as the power amplifier.

The whole equipment, including the battery power supplies, is housed in a metal carrying case with shoulder strap, the strap becoming the aerial if so required—though for long distance control, it is better to hook the aerial to a convenient tree or the like—and to employ an earth wire immersed in the water.

In order to obtain maximum range, 180 volts H.T. batteries are used, though for shorter distances of say ½ mile, 60 volts would suffice.

Care is necessary in constructing the transmitter, and proper screening and wiring must be undertaken to prevent instability. A photograph, Fig. 6, shows the complete equipment in its carrying case.

Provision is made for tuning the transmitter,

Transmitter Alignment

1. Connect all supplies disconnect H.T. from P.A. Check oscillator frequency. It should be over the range 13.75 to 14.25 mc/s. If outside the range, alter the tap at the top end of the coil.

2. Set oscillator to about middle of its range. Insert milliammeter in series with grid resistor of P.A. at earth end. Tune oscillator anode for maximum grid current. It should be over 1 m/a.

3. Tune P.A. anode circuit, and note the dip in grid current. Adjust neutralising condenser T.C.2 for minimum dip.

4. Connect H.T. to P.A. Complete fine adjustment of T.C.2 for minimum dip of P.A. grid current. (*Note.*—The dip will be greater, even when neutralised, than when P.A. had no H.T.) A figure of 0.2-0.3 m/a is satisfactory.

5. Stop oscillator and time P.A. anode from

*Continued from page 604, " M.E.," June 10, 1948

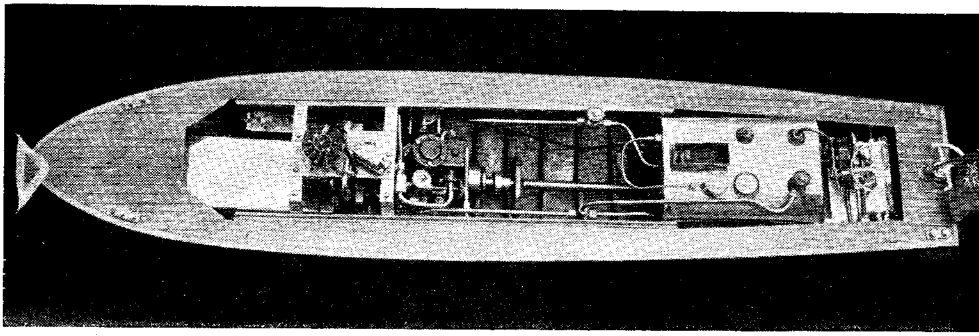
maximum to minimum. Check that there is no tendency for P.A. to oscillate, as shown by dip in anode current.

6. Remove meter from P.A. grid leak. Tune P.A. anode for minimum current. Connect aerial. Check that P.A. anode current rises from about 6 m/a to about 12 m/a. Check that tuning point has not changed, as shown by dip in anode current. If it has, reduced capacity to bring in tune means aerial too short. Increased capacity means aerial too long. Alter aerial length until change is small.

7. The anode voltage may be increased to 180 volt to increase power, but screen supply should not be increased above 150 volt. The above readings were obtained with $V_a = V_s =$ 90 volt.

8. When setting up in the field, it is undesirable to have to read the grid current of the P.A. The tuning of the oscillator anode may be checked by observing the P.A. anode current. Retune the P.A. anode, i.e. turn to maximum or minimum capacity. Adjust the oscillator anode tuning condenser. The P.A. anode current will show a rise with a dip on each side as drive is altered. The correct operating point is that which gives the maximum reading of the peak between the two dips. The P.A. anode current will rise at the extremes of the tuning range, due to disappearance of drive, so that a graph of P.A. anode current against oscillator anode tuning will be of the form shown in Fig. 7. After adjusting the drive, the P.A. anode circuit is brought into tune as previously described.

One of the major difficulties in the past has been the weight incurred by carrying sufficient electrical supplies to operate controlling mechanisms.



Plan view of boat with superstructure removed

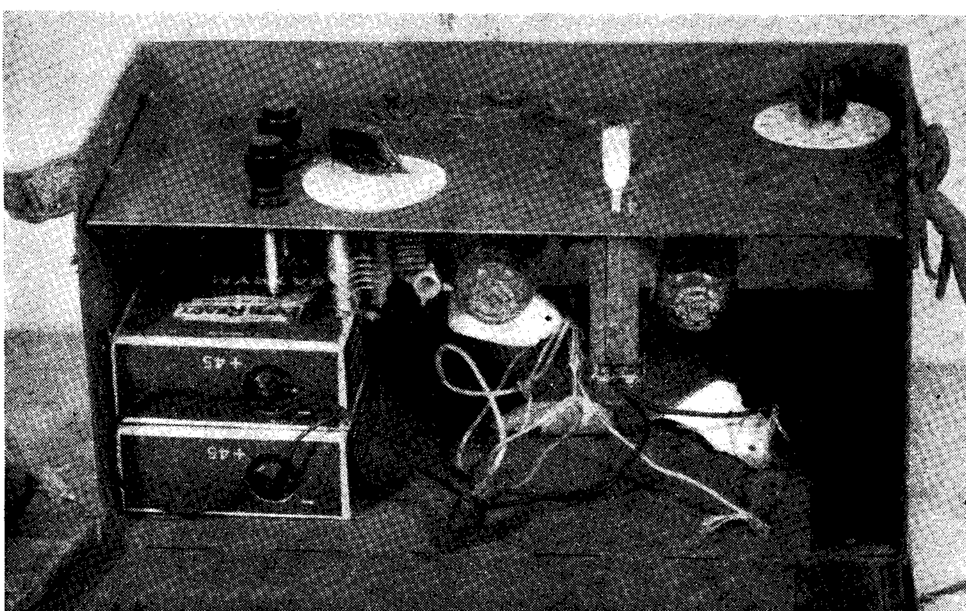


Fig. 6. The transmitter with batteries in carrying case

In the *Miss Lexington I*, steam energy from the boiler is utilised, and all the electro-steam "Servo-mechanisms" are selected at will by means of an automatic switch device, which is, in effect, an auto-pilot.

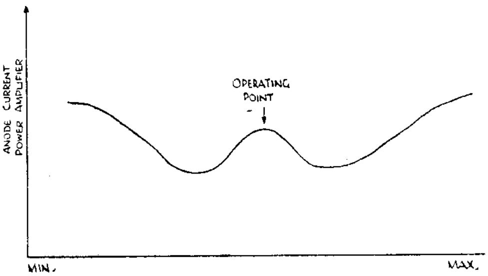


Fig. 7. Curve of P.A. current against oscillator anode tuning

This device, as shown in Fig. 8, consists of two six-pole Yaxley switches, mounted on a spindle, and ratcheted so as to rotate one contact at a time ; the whole is turned by a twin-cylinder steam motor, which is arranged with spring return and engages with the ratchet gear by means of a pawl.

The steam is fed to the auto-pilot through an electrically-operated cock. Much time was given in the design of this apparatus, as it is required to give quick snap action, working direct from the radio receiver relay, so that it may faithfully follow the fast impulses sent by the operator with lag.

The cock is driven by means of a quadrant and pinion, and a "Frog" electric motor which, together with all the other electrical equipment —except the radio—is powered by two $4\frac{1}{2}$ volt flashlamp batteries.

It is, however, the only motor operating direct from the radio and does so every time an impulse is sent, its function being only to turn the selector switch to the various positions required by the operator.

Fig. 10 shows the arrangement by which

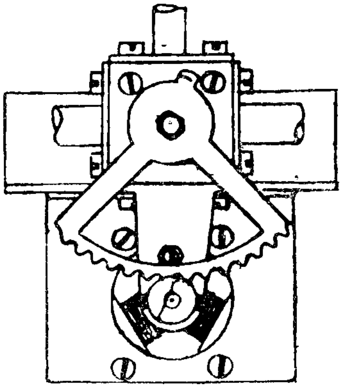


Fig. 10. Auto-pilot servo-cock

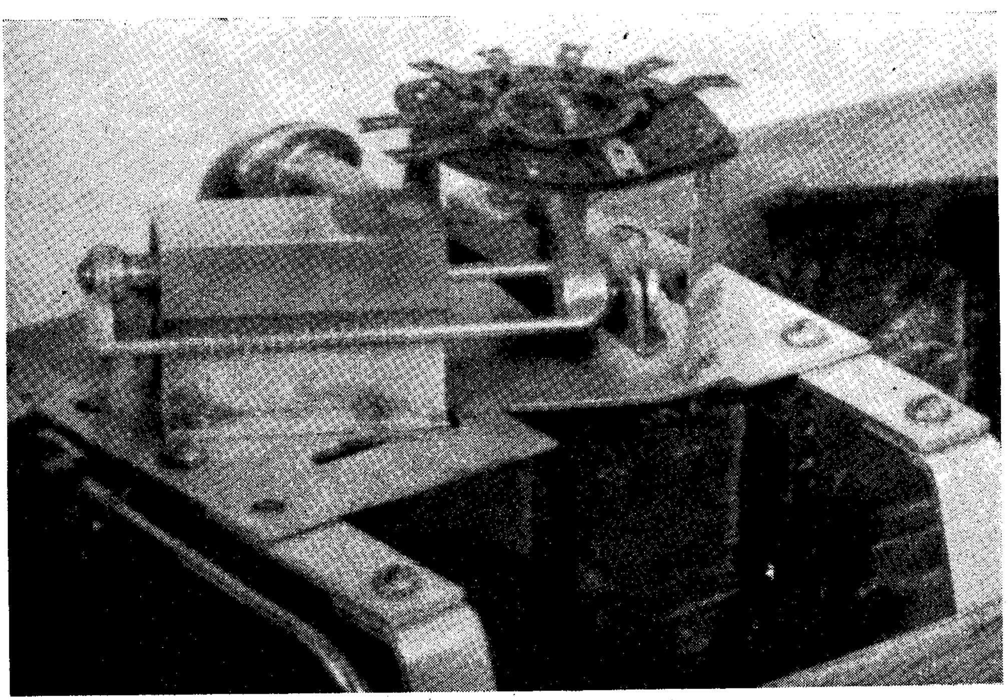


Fig. 8. A close-up of the auto-pilot

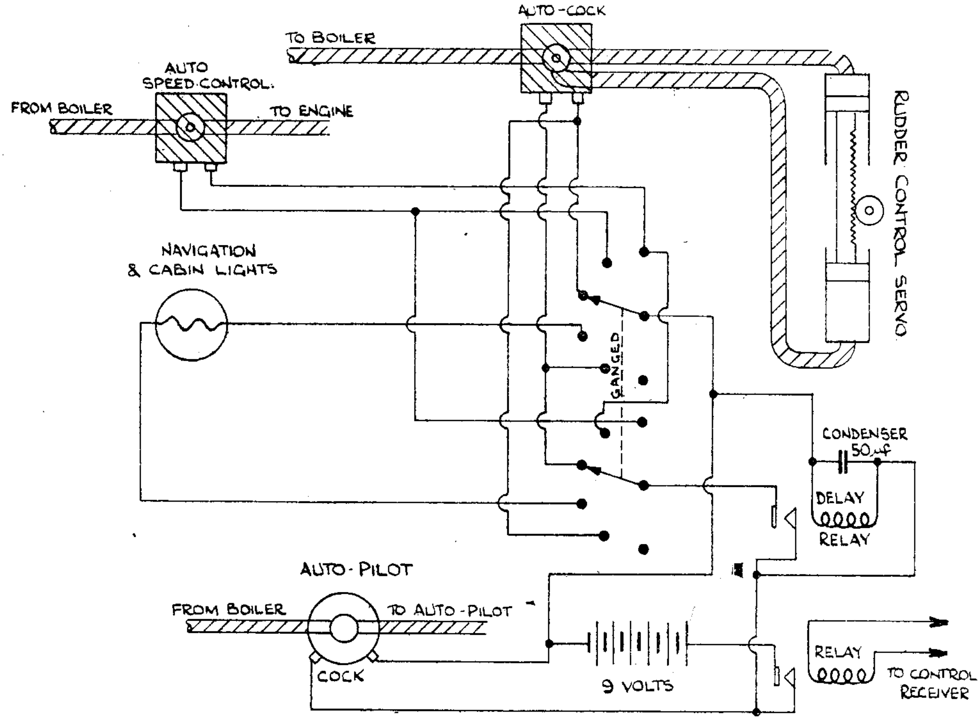


Fig. 11. *Electrical circuit diagram of wiring to servo mechanisms*

the electric motor operates this cock through the quadrant. Fig. 11 is a complete electric installation wiring diagram and from this its general use is clear.

The Delay Relay

Some sort of delay is, of course, necessary during selecting operations of the auto-pilot, and this can be quite easily arranged with a standard relay, by the simple expedient of putting a suitable condenser across the energising coil, as shown in Fig. 11, though a slug relay—as used in telephone exchange systems—would be equally suitable and as both types are available it will serve no purpose to deal with constructional details whilst the method of connecting to the control apparatus is shown in Fig. 11.

(*To be continued*)

For the Bookshelf

Fun with Physics. By Frederick Jeffs. (London: Southern Editorial Syndicate Limited.) Price 4s. 6d., postage 4d.

In a world so packed with scientific marvels, the modern youth is perhaps in danger of losing the capacity for wonder. The simple things of science, which were a never-ending source of thrills for the juveniles of a past generation, seem to rouse hardly any enthusiasm in a rising generation sated with television, radar and jet propulsion. Nevertheless, there is a world of interest in simple physical experiment if one cares to seek it, and apart from educational value, it can provide entertainment and recreation for both young and old. The author of this book has selected a number of experiments based on simple physical laws, which can be performed simply and safely in the home, and are inexpensive to carry out, requiring neither elaborate equipment nor materials which are difficult to obtain; in some cases only odds and ends of scrap material are called for. Subjects dealt with include models in glass, magnets, electric currents and static charges, heat, light and sound; the final chapter describes a miscellany of interesting experiments under the heading "lucky dip." The book offers an answer to the problem of selecting a suitable gift for an enthusiastic youngster.